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Angola Energy Sector Needs Assessment

Emergency Response Study

Contract LAG-I-200-98-0006-00
Work Order 167

Final Report

Submitted By:

 **Nexant**

August 2003

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SECTION 1 INTRODUCTION

Nexant, under its contract with USAID, has been assigned the task of conducting a diagnostic needs assessment of the energy sector in Angola. Energy is fundamental to the economic development of the country. Currently, the majority of the population does not have accessible, reliable supplies of energy. Moreover, as the Government of Angola (GOA) transitions from a wartime economy to peacetime economy, its capacity and resources are being severely tested as it confronts innumerable decisions and countless priorities. The GOA recognizes that now that peace has been achieved it must demonstrate to the population at large, in a relatively short time, that the government can return the country to a normal economic environment which will provide the benefits of economic growth. Restoring reliable supplies of energy is a key priority of the GOA. Accordingly there is a timely need for this study.

This assessment was based on available information and data; a bibliographical list of documents is provided as **Appendix A**. In addition, a team comprised of private sector, power, petroleum and natural gas, finance, environmental, and human resource specialists conducted in depth meetings with key energy sector stakeholders over the period from June 10 to June 27, 2003. The findings of this report are based, for the most part, on the results of those meetings. In this regard we would like to express our appreciation to the US Embassy, USAID Mission in Angola, the Ministers of Energy and Water, Petroleum, and Finance, as well as the senior management of Empresa Nacional de Electricidade (ENE), Empresa de Distribuicao de Electricidade (EDEL), and Sonangol for their generous assistance. A complete list of all meetings conducted in country is set out in **Appendix B**.

1.1 Objectives, Scope and Approach

The objectives of this task are to determine the critical areas for technical assistance (TA) to Angola's energy sector to support rehabilitation, restoration, and expansion of energy services to support economic development and facilitate and promote private sector investments in order to develop a commercially viable energy sector.

The scope for this task was comprehensive in that it included an examination of all aspects of the energy sector: power, petroleum, natural gas, rural energy, renewables and energy efficiency, finance and human resources. Our focus was also time differentiated into two components:

- A short term (current to 2 years) emergency assessment which focuses on the immediate needs to rebuild and rehabilitate the energy system; and
- A mid- to long-term assessment (5 to 10 years) focusing on technical assistance which will provide support for the transition of the energy sector to commercial basis (mid-term) and future development and growth (longer term).

This report focuses on the short-term emergency needs assessment. A second report, which builds on this first report, will focus on the mid- and long-term needs assessment.

The approach was based on a combination of interviews, data collection, analysis, and professional judgment. It was necessary to provide a cogent assessment of the current situation as well as develop a provisional assessment of the future developments in the sector. We did not develop an energy strategy per se, as this was beyond the scope of this task, however it was necessary to understand what drives energy development in Angola. Based on this we determined: a) what immediate action is needed to insure energy availability and stability, and (b) in the medium and longer term, what is required in terms of a technical assistance program that will encourage private investment and develop a reliable, efficient, transparent, and commercially viable energy sector.

1.2 Current Studies and Activities by Donors and the Private Sector in Energy

During the course of work we took stock of what other energy activities or studies are currently being provided or have been completed recently (i.e., within the past two to three years). As one might expect most if not all donor assistance is focused on humanitarian and health related assistance in Angola. There have been a number of commercial studies completed for Sonanagol. These activities/studies that were identified are as follows:

- The World Bank recently issued a country framework draft report in February 2003 entitled "Opportunities for Private Participation in Infrastructure". This report assessed the power and gas sector, among others, in terms of the current institutions, laws and regulations, and investment needs in terms of the potential for private investment and the barriers to private participation. The Bank's mission in Angola does not currently have or is even considering assistance to the energy sector in the near-term.
- NORAD, the Norwegian development assistance agency, has an energy and environment program in Angola. They have been providing assistance to the Government of Angola since the early 1990's. A bi-lateral agreement exists between the Norwegian Directorate for Water and Power and the Ministry of Energy and Water (Ministerio da Energia E Aguas or MINEA) to provide institutional strengthening. It also provided funding for spare parts to ENE. This three-year contract, funded in the amount of approximately \$7 million, will expire in 2004, and is now under consideration for renewal. A similar bi-lateral agreement exists between the Norwegian Petroleum Directorate and the Ministry of Petroleum. Overall results have been mixed due to lack of skilled counterparts. **Appendix C** sets out the scope of the agreements.
- The Portuguese are planning to establish a training institute for the power sector. In addition they also provide funding to Angola to support its participation in Southern African Development Community (SADC) and have provided training to the Directorate of National Energy (DNE) staff in electric sector regulatory issues.
- MINEA's planning department has completed a strategy for the power sector. This was completed in September 2002 entitled "Angolan Electric Sector Development Strategy". The strategy proposes a number of broad strategies for both near- and mid-term implementation. It is currently being updated with respect to the short-term

strategy and will be again submitted to the Council of Ministers for approval. This document is discussed in more detail in **Section 3**.

- KPMG, the consulting and auditing firm, recently completed an organization study for ENE. This was not made available to the team. However in discussions with KPMG they indicated this was a complete review – structure and staffing-of the entire organization. It is currently under review by the Chairman of ENE.
- KPMG has also completed a petroleum product distribution cost study for Sonongal Distribution. This study was not available to the team.
- A gas planning study was undertaken for Sonongal by a private consultant in November 2001. The study examined alternative options for utilizing natural gas. The study was not available to the team.
- The LNG consortium led by Chevron Texaco and Soanagol have completed feasibility studies of the proposed LNG facility. These were not available to the team
- Kellogg Brown & Root in association with Purvin and Gurtz conducted a feasibility and market study of the proposed 200 thousand barrel per day refinery in 2000 for Sonangol. This study is considered proprietary by Sonangol and made available only to potential investors in the refinery.

Funding for social and economic development of small and medium size enterprises is coming from a number of sources. While energy applications are currently not on the agenda, there is the potential to use some portion of these funds for small energy enterprises. Under the title of the “Global Development Alliance”, the U.S. Government (USG) is encouraging increased participation and cooperation of multi-national private companies in the national development agendas supported by U.S. development assistance. In Angola, this effort is focused on the creation of a credit facility for enterprise development. To date, UNDP has provided funding for and managed some initial studies of the conditions and prospects of small and medium business sectors. The USG intention is to provide further technical assistance to create the structure and organization of the fund which will then be capitalized by contributions from ChevronTexaco in the amount of \$25 million. (This \$25 million is in addition to the obligations for social investment donations under the oil companies’ operating agreements with Sonangol as discussed below.)

In addition to the above fund, each oil producing company operating in Angola, whether under the earlier joint venture agreements or the newer production sharing agreements, is obligated by the GOA, through the direction of Sonangol, to dedicate a proportion of their operating revenues to social projects and local donations. Each company has a different approach for the application of these required charitable funds, but in the end all contributions are coordinated and approved by Sonangol. These ‘social contributions’ are a mandatory annual business cost that the GOA allows to be expensed from their revenues prior to taxation.

1.3 Balance of this Report

The balance of this report is as follows:

- Section 2 presents an overview of the current energy situation and sets out key findings for immediate attention
- Section 3 sets out a strategy for the technical assistance program
- Section 4 discusses overall energy policy and planning
- Section 5 addresses the critical needs of the power sector
- Section 6 addresses the petroleum sector
- Section 7 addresses the natural gas sector
- Section 8 addresses the role of renewable energy, energy efficiency and rural electrification in the near term.
- Section 9 addresses the overall proposed emergency assistance program

SECTION 2 OVERVIEW AND KEY FINDINGS

2.1 Macro-Economic Context

The GOA's macroeconomic objectives, as expressed by the Minister of Finance in a meeting with the Nexant team, are twofold:

- Stabilization of the economy through management of the deficit and reduction of inflation; and
- National reconstruction of infrastructure.

According to the Minister of Finance, achieving these objectives are critical to the confirmation of peace in Angola. Economic growth in Angola is driven by the petroleum sector. The Gross Domestic Product (GDP) growth for 2003 is estimated by the Ministry of Finance (MOF) to be approximately 3% in 2003 and 7% in 2004. Approximately \$800 million has been budgeted this year for infrastructure rehabilitation. Of this amount, approximately \$200 million is targeted for the power sector.

Angola is presently facing a fiscal crisis of significant proportions resulting primarily from years of civil war and ethnic conflict. This is compounded by heavy government reliance on subsidies for such basic products and services as petroleum products and electricity designed to offset the impact of hyperinflation on the general populace. In 1991, external debt as a percentage of GDP was 87.5%. According to the IMF and World Bank, the current figure is somewhere between 100% and 150% of GDP. The reason for the present ambiguity is the lack of transparent and reliable fiscal data and the Government's propensity in the recent past to enter into extra-budgetary loans backed by oil. The Government continues to over-extend its financial reach through the use of quasi-fiscal, extra-budgetary means rather than submit itself to the financial and economic discipline that would be required under an IMF Structural Adjustment / Standby Loan Facility and multilateral development bank sector loans. In this regard, the Government has just concluded a new \$1.15 billion emergency offshore loan for urgent near-term budgetary support, including social programs and consumer subsidies, backed by future oil production to be repaid over the next five years.

2.2 Energy Sector

Angola's energy sector could be described as bipolar. At one end of the spectrum, the petroleum sector has significant private sector participation and is well managed, although the parastatal Sonangol dominates the domestic petroleum market. At the other end of the spectrum, the power sector has been devastated by civil war and is essentially in a state of rehabilitation in order to establish some sort of normalcy. Accordingly, our needs assessment focuses mainly on the latter sector. **Figures 1 and 2** show the structure of the power and petroleum sectors, respectively.

Total final energy consumption amounted to 234 trillion Btus (5.6 Million TOE) in 2000. This comprised 43.9 trillion Btu (18.8%) of petroleum products, 20.9 trillion Btu (8.9%) of

natural gas, 4.0 trillion Btu (1.7%) of electricity, and 164.9 trillion Btu (70.6%) of solid biomass. Per capita energy consumption is estimated at 17.3 million Btu.

Production of energy amounted to 1,707 trillion Btu (41 million TOE) of which 85.4% was crude oil, 1.2% was natural gas, and 0.3 % was electricity. Approximately 150,000 tons of oil products or 14.0 % of total oil products supply are imported. There are no imports or exports of electricity as Angola has no interconnections (except for an agreement between ENE and NamPower to import 1.5 MW of power from Namibia into Cuene Province in the south).

In 2002, the refinery produced 1.77 million tons of petroleum products consisting of 5.9% gasoline, 26.0% gas oil, 19.9% jet fuel, and 1.9% LPG.

It should be noted that the data on energy consumption is very rudimentary and comprehensive data is not prepared on a consistent basis. This is a critical area for technical assistance as a basis for informed energy policy decision-making.

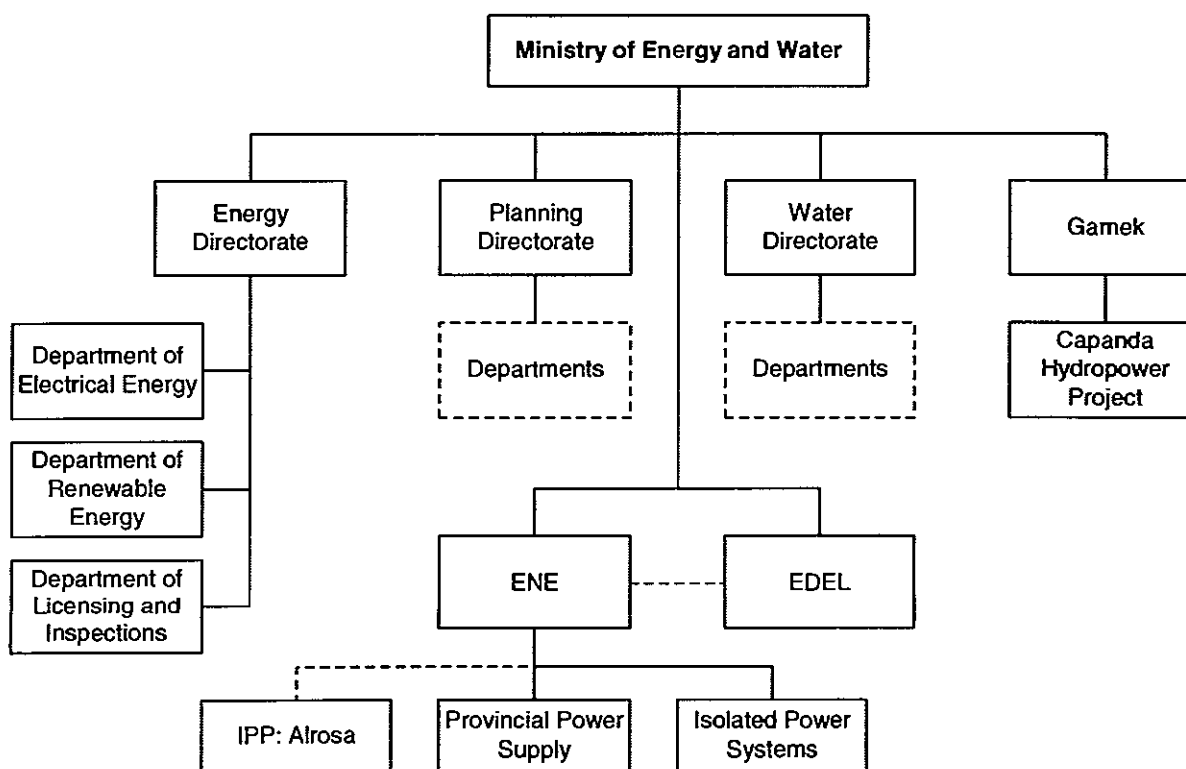


Figure 1: Power Sector

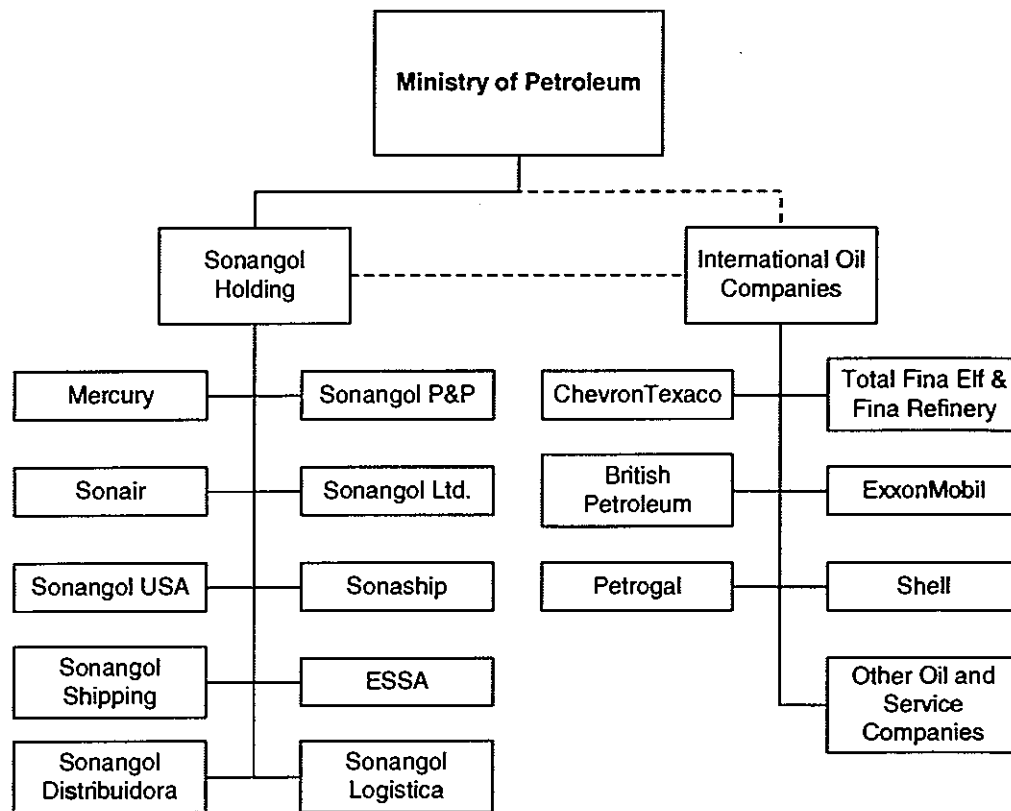


Figure 2: Petroleum Sector

2.3 Environmental Management

Protection of environment in Angola is governed by the General Environmental Law (Law Number 5/98) that was passed by the parliament in 1998. Article 16 of the Environmental Law lays out the broad framework of environmental management as an obligation for actions that impact the social and environmental equilibrium. It also lays the foundation for specific environmental legislations in various sectors that will be published by GOA.

The Council of Ministers issued the decree 39/00 on “Environmental Protection for the Petroleum Industry” in 2000. This decree defines a framework of regulations that the oil companies have to follow in order to carry out exploration activities in a concession block in Angola. It is the responsibility of the operator of the block to ensure that all environmental requirements as set forth by the decree are fulfilled.

There is no specific decree for environmental protection in the power sector. It is however planned by the Ministry of Urbanization and Environment to prepare general and sector specific Environmental Impact Assessment (EIA) guidelines. These sectors will include, but not limited to, power, agriculture, and fisheries. It is also planned to draft sector specific decrees similar to the petroleum sector.

2.4 Key Findings

There are a number of key findings of an emergency nature, which emerge from our assessment. These are as follows:

- Although limited planning capacity exists in both the Ministry of Petroleum (MOP) and MINEA, the GOA lacks a comprehensive energy planning and policy framework that addresses all sectors on a consistent basis. Energy data collection and reporting is not performed on a comprehensive and consistent basis;
- There is a critical lack of skilled staff within the GOA and the power sector. This has significant implications for focused technical assistance capacity as it relates to finding suitable counterparts;
- While an electricity law exists which establishes the legal basis for a regulator, no definitive action has been taken to staff the regulator. There is however a will to initiate the process by developing an organization and staffing plan;
- Energy prices are heavily subsidized, however there is a strong desire on the part of the GOA to reduce these subsidies in order to improve fiscal management. There are significant social and political implications which will affect the timing and magnitude of these reductions;
- The MOP is in the process of drafting a new petroleum law, however the law does not address the downstream activities and the role of the private sector in these activities;
- A plan for reducing gas flaring exists which focuses on re-injection, offshore processing, and the development of a Liquefied Natural Gas (LNG) facility;
- There is no fiscal regime or enabling legislation which addresses gas development;
- The power sector is basically operating on a day to day basis and focuses solely on the rehabilitation of the system – the magnitude of the rehabilitation planning and implementation is beyond the capacity of ENE and EDEL;
- Approximately 80% of the provincial capitals do not have reliable supplies of energy;
- Both ENE and EDEL are incurring losses due to tariffs that do not recover costs coupled with inadequate metering, billing, and collections. Both companies rely on subsidies from the Ministry of Finance which is also responsible for setting tariffs;
- Given the GOA, ENE and EDEL's focus is on rehabilitation, very little attention is being given to rural energy – although this is addressed in the previously cited power sector strategy as a key area for future development;
- The potential for private sector investment in the near term is highly unlikely although the potential exists for the use of selective management contracts; and
- There is a General Environmental Law with minimum enforcement by the GOA. There is essentially no environmental regulation of the power sector. There is a decree on environmental protection governing the activities in the petroleum sector but most International Oil Companies (IOC's) have their own corporate environmental management programs.

The basis for these findings and the technical needs associated with them are discussed in more detail in the following sections.

SECTION 3 EMERGENCY TECHNICAL ASSISTANCE STRATEGY

Based on the Nexant team's extensive interviews and collective judgment, we developed a four-pronged strategy for technical assistance. The objective of this strategy is to assist the Angolan energy sector emerge from its rehabilitation phase and establish a basis for moving into the mid-term transition phase where there would be more emphasis on commercial operation and system performance. The four strategic elements are:

1. Strengthen the GOA's energy policy decision-making and planning framework;
2. Build out the legal and regulatory framework and attendant institutional capacity;
3. Strengthen the power sector ability to plan and implement a rehabilitation program, and perform on a commercial basis; and
4. Develop mechanisms to improve access to energy and demonstrate how private sector can play a role in rural energy.

This strategy underpins the technical assistance programs identified and discussed in the following sections.

SECTION 4 NATIONAL ENERGY POLICY AND PLANNING

Energy related policy development and planning is currently carried out by MINEA for the power sector and MOP for the petroleum sector. In addition the Ministry of Planning undertakes planning principally as it relates to the implications for the national budget. Sonangol also undertakes planning as it relates to its activities in oil production, refining and the development of natural gas. There is no coordinated planning of the energy sector. As a result there is no overall vision, development strategy, or policy framework. All planning and decisions are done on a piece-meal basis. The implication is that this may result in a less than optimal use of energy resources given the extremely limited public resources available for energy development.

Accordingly, a major finding of this report is that there exists a critical need for an integrated energy strategy which would establish a national vision for the sector, develop goals and set out a policy framework. The need is critical because the GOA is confronting a number of decisions in the energy sector that will require the optimal use of scarce resources. Moreover the public at large urgently needs to see progress in restoring reliable energy supplies. It is recommended that near term technical assistance be provided in this area.

Table 4.1 sets out the major elements of such a program. It should be pointed out that before any technical assistance be provided that a counterpart task force be established by the GOA. At present there is no such coordinating body. As a pre-requisite for initiating such a project, agreement would have to be obtained from the highest levels of government with the concurrence of the MINEA and MOP. In fact such an all-encompassing undertaking may require a special decree that will have to be approved by the Council of Ministers.

Table 4.1 National Energy Policy Technical Assistance Program

Program	Executing Agency	Beneficiaries	Rational and Objectives	Scope – Key Activities	Expected Outcome	Performance Criteria	Implementation Timeframe
National Energy Strategy and Policy Framework	Special GOA Task Force	GOA ENE EDEL MOP MINEA Public	Promote least cost energy development, improve access, and contribute to economic development. There is a lack of coordinated energy planning. GOA needs to make critical energy decisions with scarce resources.	1. Energy database and analytical tools 2. Review of studies 3. Supply assessment 4. Demand assessment 5. Energy price assessment 6. Rural energy assessment 7. Structural and commercialization assessment 8. Policy objectives and framework 9. Implementation plan	A comprehensive framework for rationalizing and optimizing energy development which sets out a vision and development goals and objectives detailed energy plan	1. GOA establishes Task Force 2. GOA provides TA Counterparts and access to data 3. TA team on the ground 4. Completion of TA study 5.. Acceptance by GOA	2003-2004

SECTION 5 POWER SECTOR NEEDS ASSESSMENT

5.1 Overview

Current Supply and Demand

There are three major systems and a number of isolated, standing alone systems. The North System covers the provinces of Luanda, Bengo, Malanje, Kwanza Norte, and Kwanza Sul. The Central System covers the provinces of Huambo, Benguela and Bie. The South System covers the provinces of Huila and Namibibe. The operation and maintenance (O&M) of the three systems is ENE's responsibility. EDEL is responsible for distribution of electricity in Luanda.

The largest of the isolated systems is in Lunde Norte, 45% owned by ENE and is used primarily for providing power to diamond mining operations. These systems are depicted in **Figure 5.1**.

The current supply of generation that is operable in the North is 358 MW with an additional 260 MW coming on line by the second quarter of 2004. Luanda is fed by the North system and represents 75% to 80% of the system load. Luanda's peak load is 260 MW. There is currently oversupply of generation in the North.

Total operable generation in the Central and South systems is 37 MW and 27 MW, respectively. The total demand in these systems is not known.

There is also 28 MW of operable generation in isolated systems in four of the 15 provinces serviced by ENE. There are 9 isolated systems operated by ENE in their service territory.

Electricity Prices

Electricity prices in Angola are highly subsidized. Tariffs are set by the Ministry of Finance based on input from MINEA, ENE, and EDEL and are uniform throughout the country. The current tariffs for electricity are insufficient to cover the supply cost. Preliminary and rudimentary data compiled by ENE indicates that the average cost of generation is approximately 4 to 5 cents/kWh for system generation and on the order of 8 to 9 cents /kWh for isolated systems while the average tariff is approximately 1.6 cents/kWh.

Electricity is highly subsidized by the Angolan government and the current subsidy is \$300 million. The plan is to reduce the subsidy to \$30 million in 2004 and increase tariffs to a price that better reflects production costs. There is an apparent willingness to pay for electricity when it is reliable. This is evident from the significant numbers of back up generators that provide power to individual buildings and businesses when the grid blacks out.

The latest tariff rate information available is from November 2002. **Table 5.1** below shows the tariff structure for ENE at the exchange rate of 75 KZ to the USD. The tariffs in Angola are also compared to the rates of other members of the Southern Africa Power Pool (SAPP) and shown to be low in all categories. The tariff for medium voltage service and low voltage service to industrial customers in Angola is comparable to the same level of service in neighboring Namibia and Zambia but the low voltage service to residences and commercial establishments is low compared to the same countries.

Table 5.1: Electricity Tariff Structure for ENE

Service Level	November '02 Tariff, (cents/kwh)	% of SAPP Average
High Voltage	1.86	NA
Medium Voltage Industrial	2.1	61%
Medium Voltage Commercial	2.4	NA
Low Voltage Industrial	2.8	70%
Low Voltage Commercial	3.2	57%
Low Voltage Residential	3.1	82%
Low voltage Low Income	1.3	NA
Low Voltage Public Institution	2.3	NA

Sources: ENE Precos da Energia Electrica, Evolucao da Tarifa, a partir de Novembro 2001; Electricity Prices in Southern and East Africa: February 2002, Prepared by: SAD-ELEC (Pty) Ltd.

Note: Total Fina Refinery and Nova Cimangola cement plant report paying approximately 3 to 4 cents per kWh. These are high voltage industrial ENE customers.

Sector Structure

The power sector within the Ministry of Energy and Water is responsible for planning and policy. ENE is responsible for generation, transmission and distribution in 15 out of the 18 provinces. ENE supplies power to Municipalities, who may also have their own generation, and to EDEL. EDEL, a state owned company, is responsible for distribution in Luanda. In Lunde Norte province the government operates the generation, transmission and distribution

for the diamond mining operations and surrounding area. The other provinces not serviced by ENE, Zaire and Cuando Cubango, are responsible for the power system.

It should be pointed out that legally neither ENE nor EDEL have exclusive franchises although in actuality they are in effect monopolies. Decree no. 43/01 canceled all existing concessions and licenses in the electricity sector in preparation for the introduction of new concession arrangements. It states that those concessions or licenses existing on 31 May 2000 were to be replaced by temporary concessions lasting a period of up to three years. Decree 47/01 regulates the physical production of electricity and gives the Council of Ministers the right to grant concessions to electricity producers. The decree covers both the public and private generation of electricity.

5.1.1 Key Issues

Based upon our assessment we have identified the following issues which have implications for any technical assistance:

Planning

- There is a lack of comprehensive data on the extent of damage, disrepair and landmine placement for generation, transmission, and distribution;
- There are no load data or load forecasts; and
- There is no current power system study or stability study for expansion or interconnection.

Rehabilitation

- Generation, transmission and distribution systems have all suffered significant damage during the war;
- The emergency repairs to the power system components were accomplished in response to destruction from the war and were not performed to the usual standards for safety and operating margins;
- Transmission towers were mined during the war reducing access for repairs and access to maintenance roads along the transmission line route;
- Procurement of equipment, materials and spare parts is done on a project basis;
- Priority for rehabilitation is based on financial reserves available and/or political considerations;
- Information and data for the power sector is inconsistent and incomplete;
- There is no overall schedule for the rehabilitation of the power sector;
- Some new construction is proceeding, in particular the completion of the Capanda Dam and transmission lines connecting Capanda to the grid; and
- Some rehabilitation work is proceeding to repair generation and a 220 kV transmission line that feeds Luanda, including defusing landmines to allow repair.

Operations

- Equipment has not been maintained due to lack of spare parts or poor maintenance programs, and practices; and
- The electric grid is not interconnected across the country reducing its reliability. As stated earlier. The grid is installed in three major systems and a number of isolated systems, each standing alone. Each of the systems is in a precarious operating condition.

5.2 Ministry of Energy and Water Diagnostic and Needs Assessment

5.2.1 Organizational Structure and Staffing

MINEA is responsible for setting the overall policy for the sector and is also responsible for oversight of the planning and building of transmission lines and generating stations. Energy side of the Ministry is divided into three parts: Electricity; Renewables and Energy Efficiency; and Licensing and Inspections. The Electricity Section consists of two people and is responsible for data collection and input to power sector planning and monitoring of electricity projects. The Renewables and Energy Efficiency Section has a staff of four people and is responsible for the development of renewable energy plans and projects. The Licensing and Inspection Section consists of 20 people and is responsible for technical inspection and licensing of small generators. The National Director of Energy has four people on staff.

The Ministry of Energy and Water is responsible for the Municipalities serviced by ENE and is also responsible for the three provinces not serviced by ENE. This would include overall planning, and oversight responsibility for rehabilitation and expansion of the systems.

5.2.2 Planning and Policy

The goals of the Ministry's Energy Department as discussed by the Minister for Energy and Water are to:

- Restore the former capacity of the electric systems;
- Build capacity with training and additional qualified personnel; and
- Develop mini- and micro-hydro plants for generation.

MINEA's Planning Department in conjunction with the Energy Department, ENE, and EDEL developed a draft strategic plan in November 2002, entitled "Angolan Electric Sector Development Strategy", which was released in the *Diario da Republica*, Series #78, on October 1, 2002. This document provides a broad summary of the status of the electric sector, the condition of the infrastructure and the legal and organizational framework. This Strategy then outlines the short term needs for recovery and rehabilitation of the electric system and lays the general groundwork for a longer term strategy for development of the sector. The document proposes several policies and strategies to improving sector operation and expansion and will be frequently referred to in this report.

The strategy was approved in principle by the Council of Ministers. It is currently being updated to reflect the Minister's priorities for the short-term strategy. Mr. Jose Maria Botelho de Vasconcelos, former Minister of Petroleum, was appointed as the Minister for Energy and Water in January 2003 and has since then visited all the eighteen provinces of the country to gauge each province's energy needs.

All new construction proposed by ENE and EDEL is approved by MINEA in coordination with the Ministry of Industry, Ministry of Agriculture, Ministry of Planning, and the provincial government where the construction is to take place.

MINEA is also involved in regional planning through participation in SADC and has been collecting relevant energy data for the last two to three years.

MINEA is preparing priority criteria for the rehabilitation of the electric grid to improve the power reliability and availability across the country. One of the priorities is to restore the network in each provincial capital at the 15 kV level and lower. In some cases the priorities for repairs are obvious and in others, there are non-economic considerations. All of the planned repairs are severely constrained by lack of finances.

The Energy Department plans to institute a Rural Electrification Program to fulfill the emergency requirement of providing electricity to schools and returning refugees to the rural areas. The National Director of Energy recognizes that the Rural Electrification Program may not be attractive to the private sector.

5.2.3 Electricity

The Ministry of Energy and Water does not have an updated load growth study. The most recent study was done by the African Development Bank approximately 10 years ago. Current projections for economic growth include 7% for the oil sector and 7% - 8% for the rest of the economy.

There does not appear to be current load information on the present system. MINEA plans to expand the electric system by interconnecting the North, Central and South systems but there does not appear to be a system study to support such an expansion. The System Expansion Study would include load flows, equipment ratings, stability and reliability. The expansion of the system would also require the establishment of a system operator which would include dispatch.

5.2.4 Proposed Technical Assistance Program for MINEA

The TA Program for MINEA is focused on providing assistance in planning for the overall system and to provide assistance to the Municipalities through MINEA. The basis for the assistance is due to a severe lack of sufficient skilled personnel within MINEA to undertake planning of such scope. The proposed assistance has three components.

The *first* component is to provide technical support to enhance policy and planning decision-making. Most of the support would be provided through the proposed technical assistance for national policy and planning program discussed previously.

The *second* component will include elements that provide national planning, priority criteria, and oversight of the rehabilitation schedule. The Ministry will be responsible for resolving conflicts between performing entities working to the same priority criteria. The criteria will

balance the importance of providing electrical service for economic growth, basic services for people, schools to reestablish education efforts, and rural electrification for the return of refugees to the countryside. The criteria for establishing the priorities of the rehabilitation program will be used by the entities planning the rehabilitation work, namely ENE, EDEL, MINEA, and the Municipalities. An important part of the TA's scope for planning the rehabilitation is the gathering of load data on a continuing basis. The data collected will assist in updating the scheduling of the rehabilitation effort and provide a basis for a load study necessary for planning system expansion. This will enable MINEA to be in a better position to expedite clearances through the government bureaucracy for import of materials and equipment.

The scope for the technical assistance would include:

- Establishment of a clear criteria to set priorities for the rehabilitation effort sufficient to develop a master schedule and resolve conflicts with competing entities;
- Production of a master schedule and tracking system for the rehabilitation effort consistent with established priorities;
- Establishment of support for expedited clearance of imported materials and parts; and
- Development of load forecasting methodology and forecasts.

The *third* part of the Assistance Program would consist of providing guidance to assist MINEA in implementing the rehabilitation program for the Municipalities and for the three provinces not serviced by ENE. The TA Program will provide means for MINEA to assist the Municipalities and provincial governments in:

- Assessing damage to equipment and establishing a damage repair schedule;
- Initiating a remedial maintenance program;
- Developing a spare parts program; and
- Preparing tenders for contractors to perform the rehabilitation work.

The scope of activities will include:

- Developing a workable rehabilitation schedule consistent with criteria established by the Ministry and the schedules of ENE and the Municipalities;
- Remedial maintenance program consistent with manufacturer's recommendations;
- Developing a spare parts program that supports operational and maintenance requirements of generation and distribution of the Municipality; and
- Assistance in the preparation of tenders for rehabilitation services.

Table 5-2 sets out the proposed technical assistance program for MINEA.

We do not see a basis for providing training assistance at this time. The basis for this decision rests on the lack of skilled personnel at MINEA. It is believed that training would yield more benefit in the mid- to long-term.

Table 5.2: Technical Assistance Program for Ministry of Energy and Water

Program	Beneficiaries	Rational and Objectives	Scope - key activities	Expected outcome	Performance Criteria	Implementation Timeframe
Major System Rehabilitation Oversight	ENE EDEL Consumers	Provide coordinated plan for rehabilitation Improve decision-making Strengthen implementation	Review assess proposed program Criteria Development Project scheduling Logistics planning Preparation of tenders Load forecast development	Logical sequence and schedule of work, clear objectives for priority of performing work, Load forecasts.	Criteria accepted by MINEA Successful application of criteria Definitive scheduling program Accepted load forecasting methodology	2003-2004
Municipality Rehabilitation Oversight	Municipalities Provinces not served by ENE Consumers	Provide assistance to Municipalities and provinces in scheduling work, assessing damage and effecting repairs.	Assess damage, repair or replace, remedial maintenance & spare parts program, repair schedule, outage plan, Tender preparation.	Effective schedule for performing work, maintenance and spare parts programs, contractors to perform work,	Schedule consistent with ENE, maintenance and spare parts program consistent with manufacturer's recommendations,	2003-2004

5.3 ENE Diagnostic and Needs Assessment

5.3.1 Organization

ENE's management structure comprises six Executive Board Members who are in direct charge of their respective areas of operation, namely, administration and finance, human resources, procurement, planning and engineering, generation and transmission, and commercial (distribution). In addition, there are three Regional Directors, one each for the north, central and south regions. These all report to a General Director who reports to an Administration Council. The Executive Board Members and Regional Directors are equivalent to Vice Presidents and Senior Managers, respectively; the General Director is comparable to a President and the Administration Board to a Board of Directors in an investor owned utility.

Overall ENE has about 4,000 employees. Of these about 3,000 are involved with the direct supply of electricity. As a result of the war ENE has a security force of over 500 people. They have about 120 people that they rate as not qualified for their jobs and another 450 people on the payroll who are retirees and dependents. ENE commissioned KPMG in 2001 to help ENE develop an organizational review and assessment for the company, but due to its sensitive nature, the Nexant team did not have access to the report. ENE did however share with the Nexant team that one of the key findings of the report was the need for a comprehensive human resource plan. This is a prerequisite before any management training could be implemented.

The goals of ENE as stated by its Chairman are to:

- Rehabilitate the system;
- Restructure and urbanize the company;
- Institute training and capacity building of personnel; and
- Become a self-sustaining institution.

ENE recognizes that there needs to be institutional upgrades in:

- Planning;
- Management;
- Commercial operation of a business including revenue collection;
- Expansion planning; and
- Technical support for generation, transmission, operations and maintenance.

5.3.2 Generation

The electricity sector of Angola consists of 48% hydro and 52% thermal generation. The total capacity for all of the generation units currently installed in Angola is 600 MW and 75% of all generation is operational. **Table 5.3** sets out the current generation in Angola.

Table 5.3 System Generation as of 2003

	Generation	Installed (MW)	Operational (MW)	Percent (%)
North	Hydro	198	180	91
	Thermal	186	178	96
	Total	383	358	93
South	Hydro	41	0	67
	Thermal	21	27	0
	Total	62	27	44
Central	Hydro	49	11	22
	Thermal	58	26	45
	Total	107	37	34
Isolated	Hydro	2.6	0	0
	Thermal	45	28	61
	Total	48	28	58
Countrywide	Hydro	290	218	75
	Thermal	310	232	75
	Total	600	450	75

Source: ENE, 2003.

The North System uses the hydroelectric potential of the Kuanza River Basin. The largest, and most important hydro plant is Cambambe, which is rated at 180 MW. The new Capanda Hydroelectric Plant is currently being built on the Kuanza River. The plant will be rated at 520 MW when completed. The first of four units, each rated at 130 MW, will come on line in the first quarter of 2004 followed by the second unit in the second quarter of 2004. Currently, there is no schedule for Units 3 and 4.

The Central system is along the Catumbela River Basin. Repairs are being made at Biopio to restore the fourth of four, 14.4 MW units. The South system is in Namibe and Huila Provinces. Repairs are being made to the third of three, 40.8 MW units at Matala Dam. The repairs of the third unit will be completed by the end of the year but will not be operational because of insufficient water flow in the river to run all three units. The river flow was controlled by the upstream Gove Dam, which was destroyed during the war. ENE plans to rehabilitate the dam to restore flow control to the Cunene River and to add 45 MW of capacity.

Another new hydroelectric plant is planned at Luanda Sul. The Chicapa facility will have a capacity of 20 MW. Construction is due to commence in August 2003. The facility will be jointly owned by Alrosa and ENE. Most of the output will be used for the diamond mining operation, while approximately 2 MW will be used to supply the local network around Saurimo. The facility's estimated cost is approximately \$40 million. It represents the first significant private sector investment in the power sector.

ENE estimates that the average growth of peak load will be 10% as discussed in meetings with them. The largest load for the North system is in Luanda, which represents 75% of the load and has a peak demand of 260 MW. The largest customers are EDEL, the distribution company of Luanda; Total FINA ELF, an oil refinery; Nova Cimangola, a cement plant; and Coca Cola. ENE also expects an increase in base load because as parts of the system are repaired and reliability improves, additional industries will start operating and load growth will accelerate. This may be particularly true for Huambo, which formerly had an industrial base. Huambo is now an isolated system due to the transmission lines that are not operational because they were damaged during the war. Even if the lines to Huambo were restored to service there is concern that there is insufficient generation at Biopio to feed the load in Huambo.

Rehabilitation Assessment

Hydroelectric plants sustained damage to the dam structures, and electrical and mechanical equipment during the war. Some thermal generation equipment has failed due to lack of maintenance and spare parts. Many of the generation units are in very precarious states of operation. Maintenance has not been performed on the generation units and repairs have been performed as a temporary measure and not up to utility standards for structural and electrical repairs. It is possible that some parts of the system could fail at any time.

The extent of the damage to generation equipment, civil works and supporting structures is not known in all cases. There hasn't been sufficient diagnosis conducted at each generating station to know the state of disrepair. In many cases it requires disassembly of the equipment or testing to determine what needs to be done to restore the equipment to a reasonably reliable condition.

The quality of the power delivered is poor due to low voltage and varying frequency. The availability and the reliability of the power system are low. There is widespread use of backup generation in industrial and commercial establishments. Stability of those parts of the systems that are interconnected is not a concern because it has been reported that the system is so weak that if one generator fails it results in a system blackout.

5.3.3 Transmission and Dispatch

The main transmission voltage in ENE's North system is 220 kV. Other transmission system voltages are 150 kV, 100 kV and 60 kV. There is a total of 2,643 kilometers (km) of installed transmission lines in Angola and only 1,008 km are operational. The 220 kV transmission system in the North is 78% operational. The 60 kV system is 14% operational in the North, 7% operational in the Central and 38% operational in the South. ENE delivers power to EDEL at 60 kV. ENE delivers power at 15 kV to other municipalities for distribution by the municipalities. ENE also has an agreement with NamPower to import 1.5 MW of power from Namibia into Cuene Province in the south. **Table 5.4** sets out data on the transmission system.

Table 5.4: Installed and Operable Transmission Lines by Voltage

	Installed (km)	Operational (km)	Percent (%)
North			
220 kV	567	442	78
100 kV	159	0	0
60 kV	496	69	14
Central			
150 kV	92	92	100
60 kV	402	28	7
South			
150 kV	228	168	74
60 kV	452	171	38
Isolated			
60 kV	38	38	100
30 kV	210	0	0

Source: ENE Data for 2003

The total transformer capacity installed in substations in Angola is 512 MVA, with 299 MVA operational. In the North 56% of the installed MVA is operational, 65% in the Central, and 56% in the South. **Table 5.5** sets out data on the transformers.

Table 5.5: Substation Transformers Operable Capacity

	Installed (MVA)	Operational (MVA)	Percent (%)
North	250	141	56
Central	148	97	65
South	101	57	56
Isolated	14	4.4	31

Source: ENE Data for 2003

Generation is not dispatched as all available units run all of the time. Each independent system is operated from one of the power plants or substations. As more interconnections are made, and more generation units come on line, the system will become more complex and require a system operator.

Many of the elements of the transmission systems are in very precarious states of operation. Maintenance has not been performed on the transmission lines and repairs have been

performed as a temporary measure and are not up to utility standards for structural and electrical repairs.

The extent of the damage to transmission lines and substation equipment is not known in all cases. There has not been sufficient diagnosis conducted to know the state of disrepair. In many cases it requires disassembly of the equipment or testing to determine what needs to be done to restore the equipment to a reasonably reliable condition.

Transmission Development and Planning

New 220 kV transmission lines are currently being built from Capanda to Cambambe and from Capanda to Melange. These are being built by Odebrecht. A Spanish contractor is working on a limited scope to remove landmines and repair, and put into service a second 220 kV transmission line from Cambambe to Luanda.

Tenders for the construction of a 220 kV transmission line from Cambambe to Luanda are currently being issued. There is also a 220 kV transmission line being prepared for tender that is to be built from Capanda to N'Dalatandi and from N'Dalatandi to Luanda. This line is necessary because the lines from Cambambe to Luanda do not have sufficient capacity. This line also provides an alternate geographic route for the transmission lines feeding Luanda.

A transmission line from Biopio to Huambo is being studied.

Future long term planning includes plans for the so called "Western Corridor Project" a 3000 MW line at Inga in the Democratic Republic of the Congo. This line may be rated 765 kV or be a High Voltage DC line. Angola signed a cooperation protocol with SNEL of DRC in September of 2002 for the supply of power to South Africa through Namibia from the Inga Dam.

Generation and Transmission Human Resources

The Generation and Transmission Department of ENE has about 500 employees many of whom are not fully qualified for their duties. Interviews with ENE's senior management revealed a great need for technical training in the areas of hydroelectric and thermal generation operation and maintenance. They also need to hire additional technical personnel, but are having difficulty in finding qualified people. A limited number of engineers are starting to be graduated by the local universities, but the demand is high and the oil companies can offer higher pay, compounding ENE's personnel problems. Oil company hiring along with the recent war has also resulted in ENE's losing skilled and experience people with electrical and technical skills. This was confirmed by the Minister of Energy and Water.

ENE as a whole has only about 63 fully qualified engineers in the work force. There are more in supervision and management, but they are not available for technical work. Clearly ENE needs to increase its technical and operating capabilities if it is to establish sustainable operation. Concurrent with its physical rehabilitation, there needs to be a rebuilding of their human resource capability. This is a short to long term effort due to the education and training activities that need to take place. ENE recognizes this and does have a limited training program both in-country and offshore. Last year, 67 people were trained internally and approximately 24 were sent abroad for specialized training mostly by equipment suppliers. This is not enough, but there is only a limited supply of candidates for training.

Unemployment is high in Angola, but the work force is poorly educated and unskilled. ENE has a literacy training program, but it too is limited.

As indicated previously there is no system operating or dispatch center at this time although one is being contemplated. The substation operators are the one's that are tasked with system operating responsibility. The need for training these employees was expressed by senior ENE management. These employees are not separately identified by ENE and apparently help out with other duties especially at the substation located at the generation plants. They are also responsible for generation dispatching duties such as bringing units online and loading units. There is also a lack of system planning expertise although ENE has a small engineering and planning department of approximately 12 people. They would like to expand this number, but again are faced with a severe shortage of technical expertise in the workforce.

In the very short term the only feasible training program that can be presented is one that will enhance the technical abilities of the employees that have superior and medium technical skills so that they can do a better job of rehabilitating the generation and transmission of the company.

5.3.4 Commercial (Distribution)

The commercial division of ENE has responsibility for distribution including metering, billing, and collections outside of Luanda. ENE is responsible for distribution in 14 of the 18 provinces in the country. ENE has 100,000 customers but only 30,000 of them are metered. The 70,000 customers that do not have meters are charged a flat fee based on a consumption level of 200 kWh per month, which would amount to approximately \$3.20 per month based on the average tariff.

ENE has a computerized system for billing and collections although it was beyond the scope of this task to assess its overall functional capability and coverage. The system was designed and installed in 2000 by a Portuguese company in conjunction with the Spanish utility Union Fenosa. It is estimated by ENE that the collection efficiency is on the order of 30% in the Luanda area but the overall collection in other areas is on the order of 60%. ENE does not have sufficient equipment and personnel to read meters, prepare bills and collect revenue. They have approximately 138 people that perform this function and 14 offices throughout the country (one in each province where ENE serves) where bills can be paid. Meters are read once in three months, yet bills are prepared every month. Bills however often go undelivered; ENE has a backlog of undelivered bills. They use "commissioners" to deliver bills, who receive a small commission when the bills are paid.

The distribution system delivers power at 3 kV, 6 kV, 15 kV, and the 30 kV levels. Transformers on the distribution systems have been burned out due to overload. There have not been sufficient replacement transformers to restore power on the secondary transformers, so other circuits become overloaded. Theft of power at the secondary level is uncontrolled which can lead to phase imbalance and uneven heating of the distribution transformer and premature failure. There is insufficient metering on the distribution system to determine the extent of non-technical losses. ENE personnel provided estimates of technical losses of up to 30%.

There is a plan to upgrade the 3 kV and 6 kV systems to 15 kV. Most of the materials and equipment on the distribution system is 30 years old and in critical need of rehabilitation.

5.3.5 Proposed Technical Assistance Program for ENE

The proposed TA Program is focused on two areas: rehabilitation and revenue enhancement. Assistance in these areas would help ENE in the achievement of its company goals. A coordinated effort for the rehabilitation work that is consistent with the overall planning of the MINEA as discussed previously. The TA will consist of support to ENE as well as the design and tendering for management contracts to assist ENE in the implementation of the rehabilitation program for ENE service territory. Revenue enhancement would provide assistance in the improvement of metering, billing, and collections. The TA will provide the means for ENE to manage the work of the Planning and Engineering, Generation and Transmission, and Distribution and Commercial Departments in:

- Assessing damage to equipment;
- Developing a remedial maintenance program;
- Developing a spare parts program;
- Establishing a damage repair schedule;
- Developing an outage plan;
- Assistance in the preparation of tenders for contractors to perform the rehabilitation work; and
- Preparing a Billing Improvement System, and meter installation program.

The scope of the technical assistance would include:

- Developing a workable rehabilitation schedule consistent with criteria established by MINEA and the schedules of EDEL and the Municipalities;
- Developing a maintenance program consistent with manufacturer's recommendations;
- Developing a spare parts program that supports operational and maintenance requirements of generation transmission and distribution;
- Assistance in the preparation of tenders for contract services; and
- Developing a plan to improve billing and collections.

Tables 5.6 and 5.7 below set out the proposed technical assistance program for ENE.

Table 5.6: Proposed Technical Assistance Program for ENE

Program	Beneficiaries	Rational and Objectives	Scope – Key Activities	Expected Outcome	Performance Criteria	Implementation Timeframe
Rehabilitation Assistance	ENE EDEL Municipalities Consumers	Critical need for timely rehabilitation of system GOA, ENE achieve development objectives Restoration of service will promote economic growth Objective: provide comprehensive plan to rehabilitate ENE system	Damage assessment Determine repair or replace Preparation of rehabilitation schedule Preparation of remedial maintenance program Spare parts program Preparation of tenders for contractors	Workable schedule Contracts with rehabilitation contractors Maintenance and spare parts programs Tender issued for rehabilitation services	Agreement on scope Agreement on repair/replace program Acceptance of schedule Successful tenders Acceptance of spare parts and maintenance programs	2003 -2005

Table 5.7: Proposed Technical Assistance Program for ENE

Program	Beneficiaries	Rational and Objectives	Scope – key activities	Expected outcome	Performance Criteria	Implementation timeframe
Revenue Enhancement	ENE	Develop strategy, tools, procedures and plan for implementation of billing, collections and metering program Improve financial performance of ENE and improve fiscal position of GOA	Review existing program and procedures Develop alternatives and associated costs Select most viable approach Develop implementation plan and budget	Billing and collections plan Metering plan	Clear assessment of existing systems Identification and quantification of workable alternatives Acceptance of results by ENE	2003-2004

5.3.6 Proposed Training Assistance Program for ENE

Training would be targeted for specific areas that would complement the rehabilitation, operations and maintenance TA and the TA for revenue enhancement. As mentioned previously any training would be contingent upon the completion or reorganization and attendant staffing plan now under consideration by ENE senior management. The training should also be dependent upon the successful completion of the TA programs. The range of specific programs, which could be provided are summarized in **Table 5.8** and described below.

Table 5.8: Proposed Training Assistance Program for ENE

Program	Beneficiary	Objectives	Expected Outcome	Performance criteria	Training	Time
Generation	ENE	Restore System	Cost efficient decisions	Faster Renovation	Renovation And Modernization of Thermal Power Plants	TBD
Generation	ENE	Efficiency	Better O&M	Increased reliability & efficiency	O&M for Diesel Power Plants	TBD
Generation	ENE	Efficiency	Better O&M	Increased reliability & efficiency	O&M for Hydro Electric Plants	TBD
Transmission	ENE	Efficiency	Reduce technical losses	Increased reliability & efficiency	Performance Improvement of Transmission Systems	TBD
Distribution	EDEL ENE	Financial	Increased Revenue	Increased collections	Performance Improvement of Distribution Systems	TBD
Distribution	EDEL	Efficiency	Reduce technical losses	Increased reliability & efficiency	Metering, Billing and Collection	TBD

Renovation And Modernization Of Thermal Power Plants

This one-week workshop will identify key issues relevant to the modernization of thermal power plants and the approaches that utilities and other thermal power plant owners are taking today in selection, planning and decision making. This workshop will provide the tools for valuing improvements in existing generation units as well as repowering plants with combustion turbines. Installation of modern distributed control systems (DCS) technology for efficient and flexible controls will also be discussed. The workshop will analyze the business considerations that go into the rehabilitation and modernization planning and implementation including issues of performance, risk environmental impact and finance. It will provide a screening procedure and criteria to enable utility personnel to identify which thermal plants are potentially suitable for modernization and promise the most immediate return on investment.

Target Audience: Mid to senior level participants from ENE thermal generation and engineering.

Expected result: The participants will have the knowledge to make the most cost efficient decisions regarding rehabilitation, rebuilding or repair of the damaged thermal power generation units in Angola. This will result in a more efficient generation and a more reliable system over time and reduce the outages and power failures that they are now experiencing.

Operation And Maintenance Of Diesel Power Plants

This one-week workshop will cover the basic principles of power plant operation and maintenance, asset management technologies related to preserving assets, modern inspection and repair techniques and plant maintenance. Preventive maintenance, maintenance scheduling and planning along with personnel planning will be discussed. Operational practices such as logging data and data analysis to optimize engine performance as well as to detect wear and maintenance needs will be discussed. Proper inventory control and spare parts practices will also be discussed as well as life extension techniques for older units

Target Audience: Mid to senior level operation and maintenance participants from ENE diesel generation plants.

Expected result: The participants will have the knowledge to improve the maintenance and operational practices at the diesel generation plants. Over time, this should result in more reliable and efficient operation of the diesel generating plants and reduce fuel and maintenance costs as well as unplanned and emergency shutdowns that they are now experiencing.

Expected result: The participants will have the knowledge to improve the maintenance and operational practices at the gas turbine generation plants. Over time, this should result in more reliable and efficient operation of the gas turbine plants and reduce fuel and maintenance costs as well as unplanned and emergency shutdowns that they are now experiencing.

Operation And Maintenance Of Hydroelectric Power Plants

This one-week workshop will cover the basic principles of hydroelectric power plant operation and maintenance, modern inspection, and repair techniques and plant maintenance. Basic concepts will be reviewed to ensure that all participants are at the same level of knowledge before discussing more advanced operational and maintenance topics.

Operational practices such as logging data and data analysis to optimize plant performance as well as to detect wear and maintenance needs will be discussed. Proper inventory control and spare parts practices will also be discussed as well as life extension techniques for older units. Reservoir management will also be discussed.

Target Audience: Mid to senior level operation and maintenance participants from ENE hydroelectric power generation plants.

Expected result: The participants will have the knowledge to improve the maintenance and operational practices at the hydroelectric power plants. Over time, this should result in more reliable and efficient operation of the hydroelectric power

Performance Improvement of Transmission Systems

The workshop will cover technical methods of reducing systems losses and maintaining voltages to provide a base from which a comprehensive transmission line loss program can be developed. Workshop instruction and discussion would include such topics as selection of wire size, transformer selection economics including loss evaluation for transmission transformers, voltage regulation and control. A basic approach to reducing transmission losses will also be discussed. Since transmission line maintenance has been neglected for so long at ENE, modules will be included on how to establish and maintain an effective transmission line maintenance program

Target Audience: Mid to senior level participants from ENE and EDEL T&D engineering and planning units.

Expected result: The participants will have the knowledge to select the most cost efficient equipment and designs for rebuilding the transmission system. This will result in a more efficient transmission system over time and reduce the technical losses that they are now experiencing. They will also have the organizational knowledge to at least start planning for an effective transmission maintenance program.

Performance Improvement of Distribution Systems

The workshop will cover technical methods of reducing systems losses and maintaining voltages to provide a base from which a comprehensive distribution loss program can be developed. Workshop instruction and discussion could include such topics as selection of wire size, transformer selection economics including loss evaluation for both distribution transformers, voltage regulation and control and the use of switched and fixed capacitors for distribution systems, voltage regulators and performing voltage profile calculations.

Target Audience: Mid to senior level participants from ENE and EDEL distribution engineering and planning units.

Expected result: The participants will have the knowledge to select the most cost efficient equipment and designs for rebuilding the transmission and distribution system. This will result in a more efficient transmission and distribution system over time and reduce the technical losses that they are now experiencing.

Metering, Billing, and Collection

This workshop will cover the processes utilized to monitor sales, ensure proper metering and billing, reduce losses and collect overdue amounts from customers. Sound business practices and good customer service will be emphasized. The training will provide a benchmark

against which participants can evaluate present practices. Actual experience implementing successful programs in other areas will be shared with the participants.

Target Audience: Mid to senior level representatives from the commercial divisions of ENE and EDEL.

Expected Result: The participants will have the knowledge to develop a strategy and be able to develop plans to improve the management of the commercial departments at each company. They should be able to develop an improved metering, billing and collection program to increase the number of customers that are metered and billed and improve the collection of revenues.

5.4 EDEL Diagnostic and Needs Assessment

5.4.1 Organization, System Description, and Planning

EDEL is responsible for distribution in Luanda. In 1999, the organization was changed from a GOA entity to a public enterprise. EDEL is led by a five person Board of Directors. Each is an Administrator of the following Departments: Transportation, Internal Relations, Investments, Finance, and Studies, Projects and Works. In addition to these departments there is also a Technical and Commercial Department. EDEL has 800 workers and they work in three areas of Luanda to maintain EDEL's network.

It should be noted that the team had limited cooperation from EDEL which consisted of one meeting with the Director of Investments and the Director of Studies and Projects. Only publicly available information was provided

EDEL has five substations, 22 switching stations, 400 transformer stations, and 300 MVA of installed capacity. Electricity is delivered to EDEL by ENE at the 60 kV level for distribution. EDEL estimates load growth of 10% to 12% in the initial years of the electrical system refurbishment and expect the growth to level off after the initial years.

EDEL has approximately 150,000 customers, of which 80% are residential and the balance make up of commercial and small industrial. There are a significant number of customers without meters and power theft represents the largest loss in EDEL's system. EDEL estimates that non-technical losses may be as high as 30% to 40%. Accordingly, the main focus of EDEL is the installation of meters and the improvement in billing and collections.

EDEL estimates that it receives only 30% of the bills that are sent out as discussed in meetings with them. The GOA is one of the primary customers of EDEL but do not pay the full electricity bill. EDEL has given MINEA a reasonable plan for tariff increases. EDEL's operating costs are currently greater than the revenues collected.

The billing system is inefficient. Many customers do not receive bills and there are very limited places where the customers can pay the bills. Not all establishments or residences have metered service. In cases where there is no metered service, bills are estimated and sent to the customer or the customer has to pick up the bill.

EDEL has an investment plan although this was not made available to the Nexant team; however, it lacks funding for the implementation of the program, which must be provided by the MOF. In fact, EDEL is incurring losses as discussed in the financial section below. A

principal reason for this situation is the low electricity tariffs set by MOF. According to EDEL, current tariff rates are insufficient to cover the costs of operations and maintenance.

5.4.2 Proposed Technical Assistance Program for EDEL

The proposed TA program for EDEL would represent a parallel and similar effort to that of ENE. As with ENE a two pronged program is envisioned: a rehabilitation and revenue enhancement program. The rehabilitation program would consist of support to EDEL to better manage the implementation of its distribution network rehabilitation program. The assistance would be provided to the Studies, Projects and Works, and Finance Departments in:

- Assessing damage to equipment;
- Establishing a damage repair schedule;
- Deciding to repair or replace equipment;
- Planning a remedial maintenance program;
- Developing a spare parts program;
- Developing an outage plan for parts of the network; and
- Assisting in the preparation of tenders for contractors to perform the rehabilitation work.

The revenue enhancement TA would be provided to the Commercial and Investment Departments. It would consist of three activities:

- Implementing a Billing Improvement System;
- Meter installation program to improve billing and monitor non-technical losses; and
- Preparing tenders for contractors to perform the rehabilitation work.

Tables 5.9 and 5.10 set out the two programs discussed above.

Table 5.9: Technical Assistance Program for EDEL

Program	Beneficiaries	Rational and Objectives	Scope – Key Activities	Expected Outcome	Performance Criteria	Implementation Timeframe
Rehabilitation Assistance	EDEL Consumers	<p>Critical need for timely rehabilitation of system</p> <p>GOA, EDEL achieve development objectives</p> <p>Restoration of service will promote economic growth</p> <p>Objective: provide comprehensive plan to rehabilitate EDEL system</p>	<p>Damage assessment</p> <p>Collection and measurement of system load data</p> <p>Determine repair or replace</p> <p>Preparation of rehabilitation schedule</p> <p>Preparation of remedial maintenance program</p> <p>Spare parts program</p> <p>Preparation of tenders for contractors</p>	<p>Workable schedule,</p> <p>Contracts with rehabilitation contractors,</p> <p>Maintenance and spare parts programs,</p> <p>Tender issued for rehabilitation services</p>	<p>Agreement on scope</p> <p>Measurement of technical losses</p> <p>Agreement on repair/replace program</p> <p>Acceptance of schedule</p> <p>Successful tenders</p> <p>Acceptance of spare parts and maintenance programs</p>	2003 -2005

Table 5.10: Technical Assistance Program for EDEL

Program	Beneficiaries	Rational and Objectives	Scope – Key Activities	Expected Outcome	Performance Criteria	Implementation Timeframe
Revenue Enhancement	EDEL	Objective: Develop strategy, tools, procedures and plan for implementation of billing, collections and metering program Improve financial performance of EDEL and improve fiscal position of GOA Will contribute to commercial operation of EDEL	Review existing program and procedures Quantify revenue loss and non-technical losses Develop alternatives and associated costs Select most viable approach Develop implementation plan and budget	Billing and collections plan Metering plan	Clear assessment of existing systems Identification and quantification of workable alternatives for billing and collections Clear indication of potential costs and revenue enhancement Acceptance of results by ENE	2003-2004

5.4.3 Proposed Training Assistance Program for EDEL

Training for EDEL should be considered only after the successful completion of the TA program and the identification of suitable qualified personnel. Once these two criteria have been met, then there are two training programs which are recommended for near term assistance:

Metering, Billing, and Collection

This workshop will cover the processes utilized to monitor sales, ensure proper metering and billing, reduce losses and collect overdue amounts from customers. Sound business practices and good customer service will be emphasized. The training will provide a benchmark against which participants can evaluate present practices. Actual experience implementing successful programs in other areas will be shared with the participants.

Target Audience: Mid to senior level representatives from the commercial divisions of ENE and EDEL.

Expected Result: The participants will have the knowledge to develop a strategy and be able to develop plans to improve the management of the commercial departments at each company. They should be able to develop an improved metering, billing, and collection program to increase the number of customers that are metered and billed, and improve the collection of revenues.

Although commercial losses are a major problem, technical losses are also quite high. Interviews with EDEL indicated that technical losses vary from 10% to 30%. In addition much of the distribution system for both companies is quite old and has not been adequately maintained. These systems are also being rehabilitated along with the transmission and generation systems and technical personnel are in short supply. EDEL is actively investing in system improvement. It recently initiated a \$5.5 million sub-station (Golfe) in the high density district of Kilamba-Kiaxi. Approximately \$3.5 million went into the sub-station and the remainder in the distribution network. The construction aims at reinforcing the existing network and relieving the district's three main zones. A workshop covering efficient distribution system rehabilitation and improvement would enhance construction such as this and update the technical skills of the limited technical personnel at both companies.

Performance Improvement of Distribution Systems

The workshop will cover technical methods of reducing systems losses and maintaining voltages to provide a base from which a comprehensive distribution loss program can be developed. Workshop instructions and discussion could include such topics as selection of wire size, transformer selection economics including loss evaluation for both distribution transformers, voltage regulation and control, and the use of switched and fixed capacitors for distribution systems, voltage regulators and performing voltage profile calculations.

Target Audience: Mid to senior level participants from ENE and EDEL distribution engineering and planning units.

Expected result: The participants will have the knowledge to select the most cost efficient equipment and designs for rebuilding the transmission and distribution system. This will result in a more efficient transmission and distribution system over time and reduce the technical losses that are presently experienced.

5.5 Financial Situation in the Power Sector

5.5.1 Current Financial Status of ENE and EDEL

ENE and EDEL are confronted with the prospect of having to arrange significant investment funds over the next five years for major reconstruction and rehabilitation programs to repair war damage and extended maintenance neglect to hydro facilities, thermal power plants, transmission systems, and distribution networks, at a time when Government on-budget support and price subsidies are being greatly reduced. This situation is further exacerbated by the fact that the GOA is not presently paying already agreed upon subsidies in a timely fashion, nor does it provide the full amounts pledged. For instance, ENE has not received a subsidy payment from the Government since January 2003, and when they do receive such transfers, these payments have typically averaged only about one-fifth of the pledged amount.

As a result, ENE and EDEL's near-term financial positions are precarious. They have been unable to cover monthly fuel bills to Sonangol, and are experiencing problems meeting current payrolls. In addition, it is unlikely that any significant revenue increases can be expected in the near-term from consumers given the lack of widespread metering, absence of a systematic billing and collection system, and the lack of payment by governmental agencies and institutions.

ENE financial statements were unavailable to the Nexant team at the preparation of this report. However the team did meet with the financial manager, who provided the following information as shown in the **Table 5.11** below:

Table 5.11: Estimated Income for ENE

Revenues and Costs	2003 (estimated) (Millions US\$)
Billed	\$42
Collected	\$14
Costs	\$36
Operating Income (loss)	(\$22)
Subsidies	\$4.8
Net Income (loss)	(\$17.2)

Source: ENE Finance Department's Manager

EDEL's financial information is set out in **Table 5.12** below. The financial projections presented in the table below reflect balanced budgets over the period 2003 to 2005 for EDEL. Importantly, the budget includes subsidies, which are not always paid and also reflect the GOA budgeting. Without the subsidies EDEL would be incurring losses in 2003 of approximately \$17.5 million. Moreover, the investment programs presented in this table probably underestimate the magnitude of required reconstruction investments, de-mining operation expenses, and costs for de-brushing major transmission lines associated with restoring the electricity system to a normal state. Finally, these proposed budgets do not take

into account possible future priority investments in the sector, such as replacement of aging diesel and combustion turbine units and installation of new hydro generating capacity, or construction of a north-south transmission line interconnecting the country's three main grid systems.

Table 5.12: Financial Forecast for EDEL for the Period 2003 – 2005

Budget Category	2003 (US\$ Million)	2004 (US\$ Million)	2005 (US\$ Million)	Total (US\$ Million)
Anticipated Receipts				
<i>Self Generation of Revenue</i>				
Electricity Sales	32,415,377	62,431,345	90,921,387	185,768,109
Other Receipts	303,075	363,690	436,428	1,103,193
Subtotal	32,718,452	62,795,035	91,357,815	186,871,302
<i>Payments from Government</i>				
Price Payment Subsidy	24,377,668	17,117,413	4,762,765	46,221,846
Budgeted Investment Subsidy	17,955,000	10,350,000	8,800,000	37,105,000
Subtotal	42,332,668	27,467,413	13,526,765	83,326,846
TOTAL RECEIPTS	75,051,120	90,262,448	104,884,580	270,198,148
Projected Payments				
<i>Operational Expenses</i>				
Salaries for Personnel	6,757,326	7,095,192	7,449,952	21,302,470
Electricity Purchases from ENE	35,488,000	55,395,000	67,617,000	158,500,000
Spare Parts and Consumables	4,000,000	4,000,000	4,000,000	12,000,000
Third Party Technical Services	3,000,000	3,150,000	3,307,500	9,457,500
Other Payments	1,278,816	1,534,579	1,841,495	4,654,890
Subtotal	50,524,142	71,174,771	91,665,899	243,067,330
Planned Investments				
Funds from Internal Sources	3,587,110	4,105,000	5,330,000	13,022,110
Funds from Government	17,955,000	10,350,000	8,800,000	37,105,000
Subtotal	21,542,110	14,455,000	14,130,000	50,127,110
<i>Financial Fees and Taxes</i>				
Financial Payments	365,376	420,182	483,210	1,268,768
Consolidated Tax Burden	2,619,492	4,212,494	6,055,424	12,887,410
Subtotal	2,984,868	4,632,676	6,538,634	14,156,178
TOTAL PAYMENTS	75,051,120	90,262,448	104,884,580	270,198,148

Source: EDEL Provisional Budget Forecast, Supplemental Strategic Plan, 2003.

With approximately 4.5 million inhabitants (out of a total population of roughly 13 million) residing within the EDEL metropolitan user region and representing fully 77% of the nation's current electricity consumption, the key to ENE's near-term financial future is how well EDEL performs over this same time period, especially with respect to revenue collection. The simple fact is that at the present time, payments by EDEL to ENE for electricity received do not even cover ENE's outstanding fuel bills to Sonangol, let alone the full cost of generation.

In the proposed national budget for the coming year, GOA is proposing to reduce price subsidy payments to the entire electricity sector from a level of approximately US\$ 300 million to about US\$ 30 million per year. At the same time, official Government on budget support for the electricity sector is also expected to be drastically reduced as well. In an effort to offset this proposed reduction in price subsidy revenue, GOA is proposing to permit an increase in electricity tariffs in an effort to reach non-subsidized levels by the end of 2004. However, such a decision requires strong political will that at least in the past has appeared lacking. Thus, it is imperative that EDEL make every effort to increase revenues collected from the sale of electricity by at least a factor of three over this three year budgetary period (as indicated in the budgetary forecasts above) and possibly by even more, just to be able to cover normal management, maintenance, and operating expenses. Unfortunately, even this major increase will be insufficient to permit EDEL to begin to undertake the major capital investments required to rehabilitate and restore the electricity distribution system in Luanda.

5.5.2 Near-Term Investment Needs in the Electricity Sector

As might be expected after an extended period of conflict and civil war, Angola's near-term reconstruction and rehabilitation investment requirements for the electricity sector are extensive and significant. A summary of these investment needs for the period 2003 – 2007 was prepared by ENE, and is presented in **Table 5.13** below.

Table 5.13: Assessment of Short-Term Rehabilitation Needs for the Electricity Sector

Type of Installation	2003 US\$ million	2004 US\$ million	2005 US\$ million	2006 US\$ million	2007 US\$ million	Total US\$ million
Northern System						
Hydro, Gas Turbine, & Diesel Units	70.0	53.6	11.4	N/A	N/A	135.0
Transmission Lines	60.4	36.9	9.7	1.5	N/A	108.5
Substations	27.6	15.9	1.1	N/A	N/A	44.6
Distribution Network	33.9	51.0	5.4	0.5	N/A	90.8
Subtotal	191.9	157.4	27.6	2.0	N/A	378.9
Central System						
Hydro, Gas Turbine, & Diesel Units	37.6	40.2	26.6	N/A	N/A	104.2
Transmission Lines	7.4	37.7	9.7	5.4	N/A	60.2
Substations	4.2	9.8	4.4	N/A	N/A	18.2
Distribution Network	31.6	55.9		N/A	N/A	87.5
Subtotal	80.7	143.4	40.6	6.4	N/A	270.1
Southern System						
Hydro & Diesel Units	22.1	19.8	13.8	1.0	N/A	56.7
Transmission Lines	19.4	38.9	7.3	2.0	N/A	67.7
Substations	5.0	5.4	2.1	N/A	N/A	12.5
Distribution Network	30.9	13.9		N/A	N/A	44.8
Subtotal	77.4	78.0	23.2	3.0	N/A	181.7
Isolated Systems						
Hydro, Gas Turbine, & Diesel Units	15.4	0.8	N/A	N/A	N/A	16.2
Distribution Network	57.2	54.4	4.0	N/A	N/A	115.6
Subtotal	72.6	56.2	4.0	N/A	N/A	131.8
System Wide Support						
Telecommunications	1.9	N/A	N/A	N/A	N/A	1.9
Subtotal	1.9	N/A	N/A	N/A	N/A	1.9
Disbursed Mini Hydroelectric						
Mini Hydro Plants	18.7	N/A	N/A	N/A	N/A	18.7
Subtotal	18.7	N/A	N/A	N/A	N/A	18.7
General Technical Support						
Technical Studies and Consultants	26.1	2.4	0.8	0.2	0.1	28.5
Subtotal	26.1	2.4	0.8	0.2	0.1	28.5
TOTAL	468.3	439.2	96.2	96.2	0.1	1,014.4

Source: ENE, April 2002

NOTE: These projected investment requirements for reconstruction of the electricity system do not include estimates for the cost of de-mining or de-brushing of existing transmission line corridors.

5.5.3 Power Sector Investment Gap

At present most of GOA's revenues are derived from the sale of oil from its production shares in various offshore blocks. Some fields are beginning to decline, and in any event, even if oil production increases overall from its current level of 985,000 barrels of oil per day to somewhere between 1.6 and 1.8 million barrels of oil per day by 2005, government royalties from the sale of production quotas will tend to lag by 3-4 years under the terms of the existing production sharing agreements as the major oil companies involved begin to recoup their exploration and field development costs. Moreover, the Government has already borrowed against future oil production for the next five years. Thus, business as usual is not an option for the Government with respect to continued price and on budget investment subsidies for the electricity sector. In addition, it should be noted that such subsidies coupled with revenue collections do not begin to cover the current cost of production, maintenance, and operation of the current much reduced system, much less permit ENE and EDEL to begin to undertake just some of the outstanding rehabilitation backlog in an effort to restore service levels to that of five years ago.

If the Government intends to reduce price and investment subsidies to ENE and EDEL as planned, then where will the funds come from to initiate a US\$ 1 billion near-term rehabilitation program for ENE alone? According to the Minister of Finance, his ministry will allow increases in electricity tariffs such that retail prices will approach non-subsidized levels by the end of 2004. However, even the Minister acknowledges that further support from new oil sales is unlikely, and that planned tariff increases will not be sufficient to bridge the power sector investment gap.

When probed regarding likely sources to bridge this impending investment gap, both the Ministers of Finance, and Energy and Water responded that they hoped to rely primarily upon multilateral and regional development banks for sector loans in the form of concessionary financing, as well as the private sector on a selected basis. However, in meetings with both the International Monetary Fund and the World Bank Group, it was learned that a major donor meeting for Angola and infrastructure loans of a concessionary nature are not under active consideration and will not be considered until such time as GOA makes tangible progress on a number of social indicators, including but not necessarily limited to a 50% reduction in extra-budgetary and quasi-fiscal outlays over year 2003 levels, satisfactory implementation of the first year of the proposed Public Finance Modernization Program, completion of the diagnostic study of the oil sector and movement to the National Bank of Angola (BNA) of all oil revenues (except those already earmarked to service oil-backed debt) and their inclusion in BNA's annual audit.

In summary, realistically it will be 3-4 years before significant sector loans can be expected from multilateral development bank sources, which only leaves the private sector as a potential partner in the near-term. However it is highly unlikely that offshore private sector investment will be forthcoming without clear actions by the GOA on meeting the IMF requirements, progress on the regulatory front, and definitive plans for rehabilitation and improvement in the financial performance of the sector.

5.5.4 The Potential for Private Sector Participation in the Short Term

This section summarizes current impediments to significant private sector involvement in the Angolan electricity sector. In addition, this section presents an overview of possible forms of private sector participation in the near term that are agreeable in principle to both Government and the local banking sector, as well as suggests possible near-term technical assistance activities that can be undertaken by USAID designed to eliminate barriers and hurdles to subsequent private sector investments in the Angolan electricity sector in the longer run while at the same time facilitate planning for more immediate forms of private sector participation intended to put ENE and EDEL on sounder commercial footings.

Impediments to Private Sector Involvement in the Power Sector

Impediments to enhanced private sector involvement in the Angolan electricity sector are presented below in the form of findings:

- There is a strong impression among foreign private investors outside of the oil and diamond mining industries that Angola remains a high risk, low reward country, especially for a basic infrastructure services provider like the electric utility industry where an investor is receiving local currency for services provided;
- It is impossible for the private sector to enter the market and compete against ENE and EDEL who are essentially selling electricity to end-users at significantly less than the cost of production and delivery;
- There are no creditworthy utility off takers for an IPP producer;
- Current electricity tariffs do not begin to cover the costs of generation, transmission, and distribution, yet alone provide for a reasonable rate of return to potential investors;
- Moreover, there is no electricity regulator despite the fact that a public law has already been passed authorizing the creation of such an entity;
- While an institution and regulatory framework actually exists for the sector, it represents a carry over from the days of a strong central planned economy, and is overly complex with multitudinous approvals at every juncture along the way to initially register an investment and then actually obtain all of the necessary permits and approvals to implement a proposed project;
- There is no formal Government strategy that sets a vision and attempts to encourage private investors and participants in the electricity sector; and
- Finally, there is an absence of a strong commercial culture in the sector.

Possible Forms of Private Sector Participation in the Near Term

A number of private sector participation modalities were considered and explored with both Government and the local commercial banking sector, ranging from outsourcing contracts all the way through full privatization or divestiture over time. These options included:

- **Outsourcing or Subcontracting** – ENE and/or EDEL would directly award subcontracts to a local firm for technical and commercial services. They would still continue to own all assets and remain responsible for costs, revenues, and profits. The subcontractor would only be responsible for its manpower costs.

- **Administrative Services Contract** – ENE and/or EDEL would still be responsible for undertaking all investments as well as collecting revenues. The contractor would only be responsible for managing those costs and activities related to defined services under the contract.
- **Management Operations Contract** – ENE and/or EDEL would still be responsible for undertaking all investments. The operations contractor would be responsible for controlling all costs and collecting revenues, and thus has full operating profit responsibility.

Based on the results of these initial discussions, a matrix of possible forms of private sector participation that were deemed applicable to the Angolan electricity sector was developed for the near term. The results of this preliminary assessment are presented in **Table 5.14**.

Table 5.14: Suggested Private Sector Participation Options in the Near Term

Time Horizon for Implementation	Urban and Grid Connected Areas	Provincial and Municipal Towns	Peri-Urban and Off Grid Load Centers
Emergency Response (Year 0 - 2)	Compete and Award a Full Management Operations Contract for EDEL	No Activity	Extend Formal 5-Year Licenses to Existing Private Operators in Peri-Urban Areas
	Create and Award Administrative Services Contracts for ENE Headquarters and Each of the Three Grid Systems	No Activity	Offer to Provide 3 -5 Year Licenses to Local Private Entrepreneurs Interested in Forming Small Rural Electricity Enterprises

5.6 Power Sector Legal and Regulatory Diagnostic and Needs Assessment

The legal and regulatory framework for the electricity sector appears to be poorly developed and inadequately implemented or otherwise utilized. The framework is lacking in many respects and is generally ineffective in its purpose. This is due in large part to the far reaching effects of the long time civil war in Angola and the GOA's near term focus on rehabilitation.

Several laws, decrees and regulations were also obtained during the assessment. However, these legal instruments are in the Portuguese language and the abbreviated term of the assessment did not allow for in-country translation and review. When the translation process is completed, the translated laws and regulations will be reviewed in order to supplement/update the initial assessment findings for the legal and regulatory framework.

5.6.1 Legal Framework

A summary list of the identified laws, decrees and regulations that comprise the legal and regulatory framework for the electricity sector is provided below.

General Electricity Law

- Law 14-A/96 (National Assembly) May 31, 1996
 - Primary governing law for operation of the sector.

Ministry of Energy and Water

- Decree law 3/00 (Council of Ministers) March 17, 2000
 - Establishes the Ministry of Energy and Water. Establishes authority and responsibility for the overall policy making in the electricity sector.

Regulations for the Distribution of Electricity

- Decree 45/01 (Council of Ministers) July 13, 2001
 - Technical standards, concessions, licenses

Internal Regulations for the National Director of Energy

- Executive Decree 72/01 (Minister of Energy and Water) December 11, 2001
 - Creates an internal National Director of Energy within the Minister of Energy and Water. Further defines the functional areas of responsibility within the Ministry.

Internal Regulations for the Department of Studies, Planning and Statistics

- Executive Decree 10/02 (Minister of Energy and Water) March 1, 2002
 - Further defines the functional areas of responsibility within the Ministry.

Electric Sector Regulatory Body

Decree 4/02 (Council of Ministers) March 12, 2002

- Establishes the electricity sector regulatory body. Defines authority and responsibility for oversight of the electricity sector.

The various legal instruments identified above are discussed in general below based on the information obtained from the aforementioned meetings. Collectively, they define the existing legal and regulatory framework for the electricity sector.

These legal instruments purport to define how the power sector should be organized, create and stipulate MINEA's role as well as a separate government body that acts in some capacity as the National Regulator. They also establish the national electric enterprise (ENE) and the electric distribution enterprise (EDEL) for Luanda.

The enabling legislation for MINEA establishes authority and responsibility for the overall policy making in the electricity sector. MINEA's authority includes supervision of activities related to generation, transmission, distribution, and use of electricity. A distinct function of the Ministry is to advise on policy making for electricity and tariff proposals.

A Council of Ministers' Decree established ENE as a public enterprise and the national company responsible for the generation, transmission, and distribution of electricity. The

Decree establishes the “social mandate” for the provision of electric service to the citizens of Angola.

EDEL was established by Decree 33/99 as a public enterprise to distribute electricity in the greater Luanda area.

Decree 4/02 established a regulator, Instituto Regulador de Sector Electrico for the electricity sector. However, this law has not been implemented and the regulator does not exist. When the regulatory body does come into existence, it is expected to be responsible for the general supervision of the electricity sector through enforcement of the General Law of Electricity.

In addition to the legal instruments that enable the major government bodies and enterprise organizations, The General Electricity Law (14-A/96) is the primary governing law for the electricity sector legal framework. This framework addresses matters related to concessions, licenses, import and export of electricity, private sector participation and a regulatory body. Power is vested in the Council of Ministers for granting concessions while the provincial governments have the power to grant licenses.

Matters related to regulating the physical production of electricity have been addressed by Decree 47/01, The Regulation of the Production of Electrical Energy. Detailed authority is given to the Council of Ministers to grant concessions to electricity producers, both public and private generators. The conditions and procedures by which a concession can be issued are also specified.

5.6.2 Regulatory Framework

The General Electricity Law (14-A/96) vested authority in the Council of Ministers to establish a regulatory body for the electricity sector. In 2002, the Council of Ministers established the regulatory body by Decree 4/02. The primary role of the regulatory body is to enforce the provisions of The General Electricity Law (14-A/96). However, the authority of the regulatory body appears to be limited in two key areas, tariff setting and license issuance. Authority for these matters is apparently reserved to the Council of Ministers.

5.6.3 Proposed Near Term Technical Assistance

By far the most significant need is for the implementation of the national regulatory commission for the sector. The rationale for this need is that an independent and autonomous body is recognized to be a critical component for effective oversight of the enterprises providing essential services or exhibiting significant market power. The reality is that the legal framework provides for this government commission but in practice it does not exist. A fully functioning, independent, effective and accountable regulatory agency is crucial for the mutual benefit of the sector participants, consumers, investors and government.

At this time we believe it would be premature to provide TA to create a regulator. There are two reasons for this: lack of focus by the GOA at this time, and lack of qualified personnel. We see this as a mid term activity. However, there is a near term assistance which will provide the platform to move forward. The TA proposed would be focused on developing a Regulatory Roadmap. The objective of the roadmap would be to set out the principle steps required to establish a regulator. **Table 5.15** sets out the proposed TA program.

Table 5.15: Technical Assistance Program for the Power Sector – Legal and Regulation

Program	Executing agency	Beneficiaries	Rational and Objectives	Scope - Key Activities	Expected Outcome	Performance Criteria	Implementation Timeframe
Regulatory Roadmap	MINEA	MINEA ENE EDEL Investors Consumers	Objective: Assist MINEA in the process to create a regulator Critical element in modern power sector Improve transparency of the sector Requisite for attracting private investment	Define steps, actions, and timeframe for creation of regulator Organizational issues and steps Experience from other countries Staffing issues, plan Development of regulations and procedures Development of appropriate tools Administrative hearing processes Training agenda Schedule and milestones	A detailed plan for the establishment of a regulatory entity	Buy in by MINEA and identification of counterpart Agreement on Scope Acceptance of the plan by MINEA	2003 -2005

SECTION 6 PETROLEUM SECTOR DIAGNOSTIC AND NEEDS ASSESSMENT

6.1 Current Situation

The petroleum sector is undergoing significant development. With the exception of product distribution, it is one segment of the energy sector that has not been materially affected by the war, because oil has been produced from offshore oil fields, especially from the Cabinda region. The outlook for the sector is very positive. The sector has significant private sector involvement through the participation of the international petroleum companies (IOC's) who will be investing on the order of \$5 to \$6 billion dollars per year over the next five years in field development. As indicated in **Figure 6.1**, ChevronTexaco has the largest production share covering over 60% of Angola's current oil output. It is followed by Total (previously known as TotalFinaElf) with a share of 36% of total oil production.

Sonangol, the state owned petroleum company, has a central role in the petroleum sector. It has four somewhat conflicting roles in the sector: concessioning, exploration and development, production manager, and participant in the oil concessions. Most of the private petroleum companies we met with felt Sonangol was relatively well managed. Sonangol sees itself evolving into a something akin to a Statoil- the Norwegian oil and gas parastatal. The Ministry of Petroleum (MOP) has a narrower role which involves setting oil policy, setting guidelines for the industry, approving development plans, issuing flare permits and implementing the "Angolanization" policy which seeks to maximize the employment of Angolans in the oil sector.

Angola's proven crude oil reserves in 2002 were estimated at 5 billion barrels.¹ Angola has the second largest oil reserves in sub-Saharan Africa after Nigeria. Its current production in Angola is approximately 985,000 barrels per day. Angola is also the second largest oil producer in sub-Saharan Africa, after Nigeria, and the fourth largest in all of Africa.

According to the IOC's operating in Angola, based on current development plans, production is expected to increase to 1.5 million barrels per day by 2005 and is likely to increase to 2 million barrels per day by 2010, where it will probably plateau and remain at that level for the next 10 to 15 years before declines set in. Most production is exported, although Sonangol provides crude oil to the local refinery.

The classification of the emergency issues set out below is more from the standpoint of achieving early action rather than the critical nature of the situation. These are as follows:

- Lack of a comprehensive planning and policy framework which considers petroleum development in the context of overall energy development;
- Lack of legal framework for the development of the downstream petroleum sector; and
- Increasing reliance on imported products as opposed to increasing domestic refining throughput- this is essentially a policy issue.

¹ BP's Statistical Review of World Energy, June 2003.

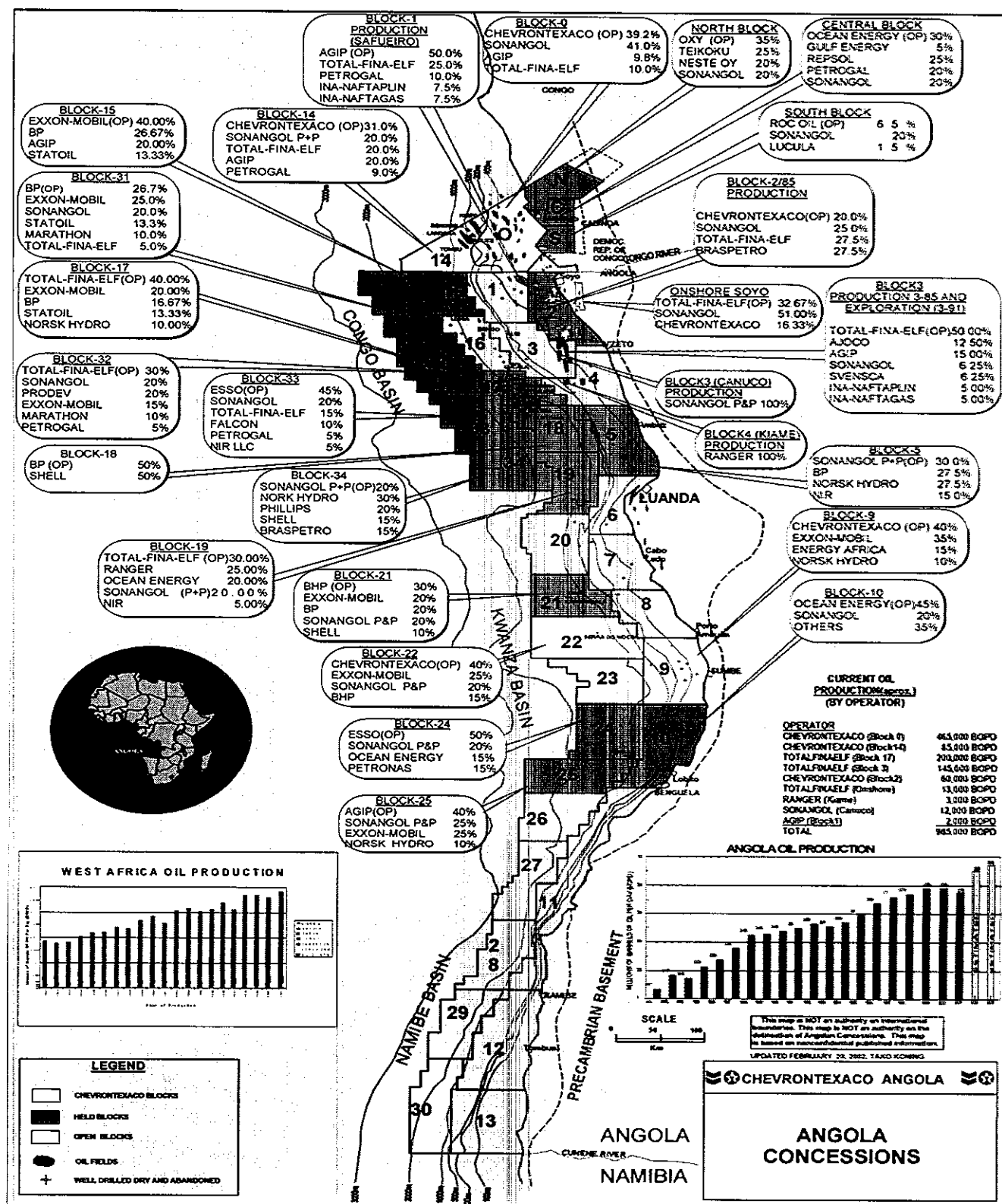


Figure 6.1: Petroleum Concession Blocks in Angola

6.2 Policy and Planning

Policy and planning activities are conducted by the Ministry of Petroleum. The Ministry's main directorate is the National Directorate of Petroleum. This directorate is involved in all the policy and planning aspects related to the country's main oil and gas developments.

The Norwegian Petroleum Directorate (NPD) is presently providing advisor(s) to support the MOP's activities and to manage Norwegian assistance to the hydrocarbon sector. For example, the NPD has provided support for the revision of the 1978 Petroleum Law. A final draft of this revised law is reported to have been completed and awaiting approval by the relevant institutions. This revised law is also reported to have "formalized" practice developed since the 1978 law was enacted.

As mentioned previously, the MOP has its own policy focus and agenda. It appears that the highest priority is on development of Angola's oil reserves and the attendant legal and policy issues associated with it. There is a plan to establish a 200,000 barrels per day refinery in Lobito in southern Angola that is being developed by Sonangol although MOP would have an oversight role in its development. It should be noted that the viability of the refinery is unclear and at this time none of the IOC's have indicated any support for the project. This is a high priority for Sonangol. Other areas receiving less attention are the development of the downstream petroleum sector and the potential use of natural gas for domestic purposes, and the role of petroleum product imports versus domestic production. All of this suggests and reinforces the need for a more comprehensive energy policy framework, which was discussed previously, and would seek to rationalize these issues in the total context of Angola's development. The associated TA was set out in **Section 4**.

6.3 Legal and Regulatory Environment

The examination of the legal and regulatory framework for the petroleum sector has been divided into two functional areas: upstream activities and downstream activities. For upstream activities, the legal framework is fairly rudimentary but is undergoing tremendous change in response to the recent growth activities in the sector. The framework for downstream activities is very poor and for the most part dates back to colonial times under Portuguese rule.

A summary list of the identified laws, decrees and regulations that comprise the legal and regulatory framework for the petroleum sector is provided below. Other legal instruments may exist but were not disclosed or were otherwise available during the aforementioned meetings and copies were not obtained.

General Oil Law

- Law 13/78 (National Assembly) September 13, 1978
 - Primary governing law for operation of the sector. Creates Sonangol as the state owned national oil company and the exclusive concessionaire for exploiting sub surface petroleum resources in Angola.

Ministry of Petroleum

- Decree law 10/90 (Council of Ministers) October 18, 1996

- o Establishes the Ministry of Petroleum.
- o Establishes authority and responsibility for the overall policy making in the petroleum sector.

Downstream Petroleum Activities

- Decree law 37/00 (Council of Ministers) October 6, 2000
 - o Defines a regime for the downstream activities in the petroleum sector.

6.3.1 Legal Framework (Upstream)

Two significant legal instruments define the framework. These instruments stipulate the creation of the Ministry of Petroleum and Sonangol.

The primary governing law for the upstream oil sector is the Petroleum Law. It is a 1978 era law and is generally considered to be out of date with respect to the robust business activities Angola is experiencing as it relates to oil exploration and production. The law provides that mining rights are granted on an exclusive basis to Sonangol. Under this law, exploration and production contracts are negotiated under the supervision and guidance of the Ministry of Petroleum. Sonangol oversees the technical and administrative control of any joint venture and production sharing contracts for which it is a party. MOP's intervention only occurs in critically important matters concerning exploration, development, and production plans and programs.

The other significant law for the sector is the enabling legislation for the Ministry of Petroleum. The law establishes authority and responsibility for the overall policy making in the petroleum sector. The Ministry of Petroleum's authority includes supervision of activities related to upstream and downstream activities.

Most notably, the 1978 Petroleum Law is undergoing a total revision and update as indicated above. This effort is being jointly undertaken by Sonangol and the Ministry of Petroleum with limited input from the international petroleum companies operating in Angola. The purpose for this revision is to make the petroleum sector more flexible and adapted to the market economy in an effort to attract more private and foreign investment. During the assessment period, the draft law was submitted to the Council of Ministers for review and approval. Following approval from the Council of Ministers, the draft law will be submitted to the National Assembly for consideration. If it is approved it will be sent to the President for his signature.

One important feature of the revised law is to standardize and streamline the licensing process for the granting of rights to the petroleum companies for engaging in exploration and production activities. Other features would shift certain authorities away from Sonangol to either the Council of Ministers or the Ministry of Petroleum. One of the overarching objectives is to clarify the respective roles and interaction of Sonangol and the Ministry of Petroleum. The Ministry should be involved with setting policy and guidelines for the sector while Sonangol should be primarily concerned with implementation and conducting business. The drafters believe that Sonangol should not have a significant role with overseeing or supervising the sector. Other features of the draft law purport to address foreign exchange matters, the customs regime, and the overall fiscal regime. We understand

that there has been relatively good collaboration between the IOC's and MOP on the development of the revised law. In addition the Norwegians have been providing technical assistance in this area.

6.3.2 Regulatory Framework (Upstream)

The Ministry of Petroleum has the authority to issue regulations for the more detailed oversight of upstream oil activities. In the absence of the availability of drafted regulations, the content and scope of oversight was generally discussed in the legal department meetings with the Ministry of Petroleum and IOC's. The scope of regulation appears to be with design, construction, metering, and operational activities in terms of mandated reviews and approvals. There are also numerous reporting requirements, both periodic in nature and triggered by certain events. Certain aspects of this oversight address environmental protection matters.

6.3.3 Legal/Regulatory Framework (Downstream)

In 2000, the Council of Ministers passed a Decree law (37/00) that purports to address downstream petroleum activities. The Decree addresses the fiscal regime related to petroleum refining, distribution, transport, and commercialization activities. More detailed information obtained during the meetings with the Ministry of Petroleum suggested that most aspects of the existing framework were subject to only minor revisions. Accordingly, this Decree could be considered as a stop gap measure until a more comprehensive framework can be developed. It was uncertain who would be responsible for this effort.

6.3.4 Identification of Critical Needs

The critical needs analysis and resulting recommendations are based on information collected during the several meetings with sector government officials, attorneys and utility executives. The most immediate need at this time is in the area of developing a downstream petroleum legal framework.

The legal and regulatory framework for oil sector downstream activities needs to be fully developed. The framework should address matters related to refinery operations, distribution and marketing of refined products, transportation, taxes, commercialization and opportunities for private participation. An associated recommendation would provide technical assistance to the Ministry of Petroleum for this program. Note that this recommendation is subject to a more comprehensive review of Decree 37/00, which purports to define the regime for downstream activities in the petroleum sector. In addition coordination with the NORAD would be necessary to insure they will not be providing assistance in this area.

6.4 Petroleum Products and Refining

There is one small refinery in Angola, the Fina Petroleos de Angola refinery located 14 km north of Luanda. The refinery is owned by Petrofina SA (61%), a subsidiary of France's Total, Sonangol (36%) and the rest by small private shareholders. The refinery, which is operated by the Total subsidiary, started operation in 1958. The team did not have the opportunity to visit the refinery facilities.

The refinery has a reported present capacity of 2.3 million tons per year or 45,000 barrels per day. In 2002, the refinery, which runs exclusively on Angolan crude oil provided by Sonangol, produced a total of 1.77 million tons of petroleum products.

According to Sonangol, domestic consumption of petroleum products in 2002 amounted to 1.8 million cubic meters. Three fuels covered about 70% of total consumption of petroleum products during that year. Gas oil accounted for the largest share (34%) of products consumed followed by Jet A1 (23%) and gasoline (10%).

Our review of the petroleum sector indicates that, as one might expect, given the significant role of the majors, there are a limited number of issues of an emergency nature. It should be noted, however, that the team could not gather information on the conditions of/ or visit the petroleum products distributions and storage facilities. It is not known to what extent these facilities have been affected/damaged by the long civil war.

Petroleum product prices in Angola are set by the government. The different elements (ex-refinery price, margins and final retail price) of the price structure are fixed by the government. Final retail prices are heavily subsidized. As indicated in **Table 6.1**, the average price subsidy for petroleum products is estimated at over 70% of the reported "actual" product values. With 60% of the LPG, 50% of the gasoline and 40% of the diesel consumption currently imported, these subsidies have a serious impact on the country's balance of payments.

Table 6.1: Petroleum Product Prices and Subsidy

	Refinery price (Kwanza)	Actual value (Kwanza)	Price charged (Kwanza)	Subsidy (Kwanza)	Subsidy (%)
LPG	31.33	52.00	10.20	41.80	80%
Gasoline	20.52	52.00	12.00	40.00	77%
Gas Oil (diesel)	14.00	29.00	8.00	21.00	72%
Lamp Oil	20.32	32.00	7.80	24.20	76%
Light Fuel Oil	15.60	23.40	6.40	17.00	73%
Heavy Fuel Oil	10.56	16.00	4.60	11.40	71%
Asphalts	9.76	15.00	4.50	10.50	70%

Source: Sonangol Distribution, June 2003

6.5 Product Distribution

All product distribution is currently under the control of Sonangol. This includes both wholesale and retail distribution, with the exception of LPG where small retailers purchase from Sonangol and sell locally. Sonangol. There is a joint venture company, Songalp, between Sonangol (51%) and Portugal's Petrogal (49%) for the retail marketing of refined products. The major impediments to improved product distribution at the present time is the extremely poor condition of the transport infrastructure. This has resulted in delayed

deliveries and in some cases requires that fuel be delivered by air transport. Obviously the associated costs are very high however these are not passed onto the retail price which, as discussed above, are significantly subsidized.

Improved product distribution will play an important role in increasing the accessibility to energy supplies and therefore fostering economic development. One way to accomplish this is to increase the role of the private sector which does not have a role at present. In order to accomplish this a first critical step would be to establish the legal framework for the downstream sector as discussed in **Section 6.3**.

6.6 Emergency Technical Assistance Program

Based on the above assessment there are two areas identified for near term technical assistance:

- Development of an integrated energy strategy and policy framework; and,
- Development of downstream legal framework.

The first area has already been addressed in **Section 4**. The second area would represent an important area of assistance. The technical assistance program is set out in **Table 6.2**.

Table 6.2: Technical Assistance Program for Petroleum Sector- Legal and Regulatory

Program	Executing agency	Beneficiaries	Rational and Objectives	Scope - Key Activities	Expected Outcome	Performance Criteria	Implementation timeframe
Downstream Petroleum Legal Framework	MOP	MOP Sonangol Private Investors Consumers	Objective: Development of the sector requires legal framework No prevailing law Requisite for private sector Increased transparency Would improve access to energy	Develop a legal framework for refining, storage, distribution and sales Experience in other countries Roles/responsibilities Private sector involvement Fiscal issues Pricing of services Regulation	Development of draft legal framework for the downstream petroleum sector	Buy in by MOP and identification of counterparts Agreement on scope Acceptance by MOP Acceptance by Sonangol	2003-2005

SECTION 7 NATURAL GAS DIAGNOSTIC AND NEEDS ASSESSMENT

7.1 Overview

The hydrocarbon sector in Angola is presently dominated by the production of crude oil. Over 60% of the associated gas volumes produced with the oil is flared, 30% is re-injected in oil fields to maintain reservoir pressure and less than 10% is consumed by the oil industry to meet the fuel needs of its hydrocarbon operations. Outside the hydrocarbon industry there is no local consumption of natural gas. The lack of an economically viable local market for gas and the long civil war have until now prevented the development of a local gas sector.

According to Sonangol, Angola's proven and probable reserves are estimated at 12 to 15 trillion cubic feet (tcf). There is no information available showing the break down between proven and probable reserves. However, outside sources indicate that the country's proven reserves are estimated at 13 tcf at the end of 2001.² It should be noted that on an aggregated basis, there are no reported concerns about the availability of gas reserves if economically sustainable local gas markets, including gas-based export projects, can be identified. As there is no large non-associated gas accumulation, the difficulty will be to design an optimal gas supply scheme to draw gas from the different associated and non-associated fields.

7.2 Gas Flaring

At present, the main concern of the Government of Angola, represented by the Ministry of Petroleum and Sonangol, is the continuous flaring of large volumes of gas. To illustrate the magnitude of gas flaring, the 400 million cubic feet per day (MMcfd) of gas presently reported as flared could fuel a Combined Cycle Gas Turbine power station with a capacity of about 2,500 MW or nine times Angola's present total installed electricity generation capacity.³

The Petroleum Activities Law 13/78 of 1978 stipulates that:

"Sonangol and its partners must submit utilization plans for discovered gas, the flaring of which is prohibited unless approval of the Ministry of Petroleum to do so can be secured; and Sonangol and its partners must take the required action to preserve and protect the environment".

But, it is clear that crude oil revenue earnings are extremely crucial to the national economy and that it will be extremely difficult to take the decision to shut down oil production operations.

The local and international concerns expressed about the magnitude of the volume of gas flared and the lack of a viable domestic market have led the Ministry of Petroleum, Sonangol and the international oil companies involved in Angola to focus their efforts to stop flaring

² Cedigaz, Paris, 2003.

³ Obviously, to undertake such a large gas-fired project, adequate reserves would need to be available to supply 400 MMcfd for a period of over twenty years.

on the development of a large-scale gas export scheme. Preliminary studies on the development of a liquefied natural gas (LNG) project started in the late 1990's between Sonangol and then Texaco. In late 2001, the Council of Ministers approved the development of an LNG project for the supply of gas to international markets. This led to the setting up of the Angola LNG Project.

7.3 The Angola LNG Project

The Angola LNG (ALNG) project has been set up as an unincorporated joint venture between:

- | | |
|-----------------|-------|
| • ChevronTexaco | 36.4% |
| • Sonangol | 22.8% |
| • BP | 13.6% |
| • ExxonMobil | 13.6% |
| • Total | 13.6% |

Norsk Hydro, which was part of the original scheme, withdrew from the joint venture recently.

The planned installed capacity of the one-train ALNG plant, to be sited in Soyo 500 km north of Luanda, is 4 million tons per annum (mtpa) or 5.4 billion cubic meters (bcm) per year. The LNG plant is expected to be fed with gas supplies from eight associated (blocks 0, 2, 14, 15, 17, and 18) and non-associated (blocks 1 and 2) fields. It should be noted here that the non-associated gas supplies would obviously cost more than the gas volumes produced in association with crude oil production. But, these supplies will certainly be part of a portfolio of supplies from both associated and non-associated gas fields.

The supply of gas to the LNG plant will require investments in field facilities and gas pipeline gathering infrastructure in addition to the large capital-intensive LNG plant. Therefore, an enabling legal, commercial, and fiscal framework will need to be in place for the international oil companies to commit investments for the implementation of this LNG project.

The Ministry of Petroleum and Sonangol are currently discussing with the Ministry of Finance and other ministries the issue of fiscal incentives (e.g., tax holiday) to be granted to the LNG project within the framework of the new private investment law. The ALNG scheme constitutes the first large-scale gas project in Angola and could serve as an anchor project for the eventual development of a domestic gas sector.

7.4 LPG Extraction

Liquid Petroleum Gas (LPG) is currently extracted offshore in the Cabinda area and the bulk of the extracted LPG (2/3 propane and 1/3 butane mix) is exported directly with condensate to international markets. Small volumes of LPG are sent onshore for local consumption. Storage spheres in Luanda, the main market for LPG sales, are only designed to handle LPG mixes with a maximum of 30% propane. But this is not the only constraint to the local

development of LPG use. Terminalling, storage, bottling, and distribution facilities will need to be expanded and/or rehabilitated for the domestic market for LPG to be developed. Furthermore, private sector participation in this expansion and rehabilitation efforts will not be possible without an adequate commercial and regulatory framework. It is believed that the World Bank African Gas Initiative is addressing the issue of promotion of LPG use.

7.5 Proposed Technical Assistance Program

7.5.1 Development of Domestic Gas Sector Legal and Regulatory Framework

With regard to the local utilization of natural gas, there is no gas regulation or law governing the development of gas infrastructure or local gas industry and the domestic marketing of gas supplies. Offshore gas operations are governed by the concession regime, where surplus gas (i.e., the gas remaining after field operation uses) is the property of Sonangol. The regulation of onshore gas operations is not clearly specified. It is reported that such operations would fall under the responsibility of the Ministry of Industry in association with the Ministries of Petroleum and Local Authorities.

If a domestic market is to be developed on the back of the LNG project, it is imperative that the Government of Angola starts, as soon as possible, work on the development of the basis for an adequate gas regulatory framework or set of regulatory guidelines/principles to be followed by the preparation of Draft Gas Act or Law. Without it, it will fail to attract suitable investors to a domestic market that is already potentially limited. Obviously, the characteristics of a nascent natural gas market in a developing economy such as Angola's will at this stage not require a very elaborate regulatory framework. It is also known that the development of such regulation could involve a protracted procedure before any legislation is enacted.

However, these aspects should not be used as excuses to stall the possible development of a domestic gas sector and send the wrong signals to potential private investors. The Government, who will need the full participation of private sector investors for the development of the gas transportation, transformation and marketing infrastructure, must take a proactive approach and initiate work on the formulation of the fundamental commercial, legal, and fiscal elements of a gas regulatory framework. For example, the critical issue of domestic energy pricing should be addressed and the roles and responsibilities of the different stakeholders should be clearly defined.

The potential use of natural gas in Angola remains limited. The power sector, which is usually the main driver of gas consumption in Angola, is dominated by the country's large hydroelectric potential capacity. Fuel substitution in thermal power units is limited to two gas-turbine units located in Luanda, provided that gas-based electricity can be generated at a competitive price level.

Several gas utilization studies were conducted internally and for the Ministry of Petroleum and Sonangol. Recently, a gas planning study was completed in November 2001 and according to Sonangol and Ministry of Petroleum (Nexant did not have access to this study), methanol and fertilizer gas-based industries have been identified as the main options for domestic gas uses. As a result, Sonangol and the Ministry of Petroleum are considering the development of gas-based export industries such as methanol and fertilizers to monetize

locally their gas resources. These two government institutions and other government agencies have been approached by international groups to promote the development of such industries and also for the development of an aluminium smelter.

The green-field development of petrochemical and fertilizer projects, which are characterized by high product price volatility and very aggressive international competition, will need to be fully assessed before any decision is made regarding such gas-based developments. Officials from Sonangol and the Ministry of Petroleum have recognized the urgent need to fully assess and consolidate the finding of existing analyses and studies to formulate a plan for the development of a National Natural Gas Strategy. It is therefore important to undertake in the coming months a comprehensive assessment, in close association with all the stakeholders, of the economically and environmentally sustainable options to be considered for the development of a gas-based industry in Angola.

The development of an enabling commercial, legal, and fiscal framework consistent with the formulation of a national natural gas strategy for Angola will require not only the participation of the Ministry of Petroleum and Sonangol, it will involve a lot of interaction between several government agencies as well as the contribution/feedback of international oil companies operating in Angola.

Presently, there is a Joint Ministerial Committee including the Ministries of Petroleum and Industry and possibly other ministries for the domestic use of the country's natural gas resources. It is not clear yet how it operates and what its role is in the development of a domestic gas industry.

Depending on the role and activities of this joint ministerial committee, it may be more efficient to consider the creation of a dedicated focused Gas Task-Force formed of technical experts from the relevant government agencies and supported by TA funds and expertise. This task force, which could be placed under the tutorship of the Minister of Petroleum or the Prime Minister's office, would act as a focal point for the coherent development of the gas sector in Angola.

The proposed technical assistance program is summarized in **Table 7.1**.

Table 7.1: Proposed Technical Assistance Program for Gas Sector

Program	Beneficiaries	Rational and Objectives	Scope - Key Activities	Expected Outcome	Performance Criteria	Implementation Timeframe
Develop the basis for a Gas Regulatory Framework	Ministry of Petroleum	Absence of a gas regulatory framework to attract investment into development of domestic gas market	Develop principles/guidelines for the development of gas infrastructure and domestic gas pricing	Development of a set of regulatory guideline/principles to prepare Draft Gas Act or Law	Draft gas law Draft regulatory framework Acceptance by GOA	2003- 2005
Full Assessment and Consolidation of existing Analyses and Studies	Ministry of Petroleum and Sonangol	Urgent need to fully assess and consolidate the finding of existing analyses and studies to formulate a plan for the development of a National Natural Gas Strategy	Review and independent assessment of all existing analyses and studies	Consolidated report with an up-to-date assessment of different domestic gas development options	Acceptance by GOA	2003- 2004

SECTION 8 THE ROLE OF RENEWABLE ENERGY, ENERGY EFFICIENCY, AND RURAL ELECTRIFICATION IN THE NEAR TERM

8.1 The Rural Economy and Energy

The rural areas of Angola (specifically the more wooded areas) produce as much as 70% of the total annual domestic energy consumed.⁴ Yet these same areas, despite their importance in energy production, do not present the socio-economic conditions to realistically make rapid transitions to modern fuels (electricity or petroleum).

The severity of the dislocation and destruction of rural infrastructure is an enormous constraint to development. Most of the near term attention being given to rural electrification. The international community has necessarily focused on emergency aid, humanitarian interventions and filling immediate needs for food or clothing. Over 4 million people were displaced by the ongoing conflict which resumed its intensity in 1998. Of these displaced persons over 70% are women and children, many of them malnourished and ill. Survey data on the social and economic characteristics of 'households' everywhere in Angola, but particularly in the rural areas is non-existent. The European Union has begun to collect data in several provinces, but the information has not yet been assembled for reporting. Unfortunately, these early efforts are focusing on structures of civil society, the needs for health clinics, schools and community organization and are not looking at consumption patterns for energy.

Anecdotally, there is almost a complete lack of a cash economy outside the provincial capitals and any distance off of the main roads. The main 'crop' or product that is traded (for cash or barter), throughout the country, is charcoal. Charcoal in Kwanza Norte, 150 km east of Luanda currently sells for 500 Kwanzas (approximately US\$ 6.50) for a bag containing about 25 pounds of soft, traditional charcoal. In Luanda the price of the same bag can be twice as much.

8.2 Renewable Energy

Although renewable energy technologies will be essential to any integrated national energy planning or re-development programs, their relative priority is low in light of the fiscal constraints and the devastated condition of existing energy infrastructure. Either using officially stated policy (Electric Sector Strategy), which emphasizes the near term economic leverage of each investment, or the 'de facto' political process that allocates scarce funds, renewable energy cannot compete.

This said, DNE asserts that in the highest levels of Government there exists recognition that renewable energy will be important to Angola's future. The DNE has a budget of \$750,000

⁴ The "Angolan Electric Sector Development Strategy", July 2002 (draft) uses the World Bank – ESMAP calculations, 65% biomass, 33% petroleum derivatives, and 2% electricity. For many reasons the distribution of petroleum products and electricity availability have fallen.

for 2003, for small scale renewable energy pilots and studies. Although DNE's focus is solar photovoltaic technologies, Angola has yet to estimate quantities of small and micro-hydro potential. For larger hydro resources the Portuguese did extensive surveys and modeling, reporting a potential hydro generation capacity of over 150,000 GWh/year, indicating that the current hydro exploitation of 1,200 GWh/year represents less than 1%.

As government and donor attention turn beyond immediate survival and humanitarian issues, all will recognize the pivotal role that subsidized renewable energy technologies can contribute to more sustainable community development. This discussion is expanded in the report on mid- to long-term needs.

8.3 Energy Efficiency

Unfortunately, again the current economic circumstances put energy efficiency issues even lower on the priority ranking for near term energy needs. More efficient wood stoves, substitution with LPG for cooking, energy efficient refrigerators or air-conditioning units will be important, but the current urgency is to distribute electricity and fuels and then impose a rational pricing structure. Once people have access to modern fuels at international prices energy efficiency will become relevant.

The greatest energy efficiency issues and the incentives to seek efficiencies are on the supply side. Generation efficiencies are particularly low in the smaller diesel generator sets and the isolated municipal systems it operates. Costs using international fuel prices and imposing proper maintenance regimes would approach \$0.20/kWh generated, yet even with transmission and distribution costs added ENE sells at \$0.012/kWh. ENE's ability to provide reliable electricity supplies is so low that the privately owned, stand-by generation capacity in the country may well exceed the installed generation capacity that ENE operates.

SECTION 9 OVERALL CONCLUSIONS AND SUMMARY

This report has presented an assessment of the current energy situation in Angola. It is in effect a “snap shot” of what factors are currently driving the developments in the sector. On a general level the power sector has the most critical needs as it tries to restore reliable supplies of electricity. There is essentially no private sector participation in the sector and it is unlikely there will be any in the near term. In contrast the petroleum and emerging natural gas sectors will have significant participation by the IOC’s.

One of the GOA’s highest priorities is the rehabilitation of infrastructure. However it is confronted with an overwhelming array of priorities and decisions in restoring the country to a normal footing. It recognizes that energy is crucial to the economic development of the country. At the same time it is trying to invoke fiscal discipline into its budget process resulting in difficult decisions in the allocation of scarce financial resources. Accordingly, the restoration of the power sector could be a prolonged process.

From a policy perspective, the MOP and MINEA have each developed their own plans for energy development. In addition, Sonongal as the national oil company also has its own plans. There is no coordinated effort to develop an overall energy strategy for the country.

The power sector lacks both financial wherewithal and human capacity to accomplish the task of rehabilitation. Moreover, it lacks the commercial processes and capability to improve its financial position. Both ENE and EDEL are incurring significant losses in part due to tariffs that are not cost reflective but also because of inadequate and ineffective metering, billing, and collection systems. It is unlikely that the private sector will play a major role in the near term.

The petroleum sector represents a totally different set of circumstances. It is and will be experiencing significant growth over the next five years. The IOC’s will be investing billions of dollars in the sector. Gas development represents a major program for the GOA and Sonangol. In this regard the development of the proposed LNG plant represents the lynchpin of the gas sector future development. A key to spurring this development will be the enabling legislation and associated regulatory framework.

The TA program set out in this report was based on the strategy set out in **Section 3**. The specific sector programs have been discussed in detail above. Prioritizing these programs is difficult as they are all viewed as fulfilling critical near term needs. However, based on the above assessment and the GOA’s priorities we would suggest the following prioritization of the proposed technical assistance programs:

1. ***Developing a National Energy Strategy and Policy:*** This would promote the consistent and least cost development of resources, and enhance the countries potential for growth, and access to energy with a coordinated effort from all the stakeholders in the energy sector with a vision and approach to manage the country’s energy resources in a sustainable manner.
2. ***Assistance to MINEA:*** The national energy assistance will fulfill part of the need while the rehabilitation planning assistance should commence in parallel with ENE rehabilitation assistance.

3. ***Rehabilitation Assistance to ENE:*** A fundamental requirement for returning the country back to normalcy. It is a very high priority of the GOA and a key objective for ENE.
4. ***Rehabilitation Assistance to EDEL:*** A fundamental requirement for economic development in Luanda. Another high priority area of the GOA and a key objective for EDEL.
5. ***Revenue Enhancement Assistance to EDEL:*** Restoring revenues will not only assist EDEL but will also provide revenues to ENE. A fundamental step towards commercial operation.
6. ***Revenue Enhancement Assistance to ENE:*** Once rehabilitation is underway, attention can be focused on improving commercial operations.
7. ***Development of Gas Law and Regulatory Framework:*** While very important it will in some degree depend on the development of the LNG plant and could commence in 2004.
8. ***Development of Downstream Petroleum Legal Framework:*** This will set the stage for the introduction of private sector to product distribution. The TA is dependent on the nature of the GOA decree in this area and the assistance that may be provided by NORAD.
9. ***Development of Regulator:*** While critical in moving the process of power sector transparency forward, given the GOA's current focus on rehabilitation, it may be difficult to find the appropriate support.

APPENDIX

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B. List of Meetings

International Government and Donor Institutions

U.S. Embassy, Angola: Mr. Christopher Dell (Ambassador), and Mr. William Ayala (Economic-Commercial Officer)

USAID Mission, Angola: Mr. Robert Hellyer (Mission Director)

British Embassy, Angola: Mr. Steven Graham (Second Secretary, Commercial), and Mr. Paulo Boa (Commercial Officer)

Royal Norwegian Embassy: Ms. Vibeke Skauerud (Program Officer)

The World Bank: Ms. Olinda M. Vieira Dias (Resource Management Analyst), and Ms. Lisa Maier (Operations Assistant)

DFID: Mr. Martin Johnston (Country Representative)

IMF: Mr. Carlos Leite (Resident Representative)

European Commission: Mr. Robert Steinlechner

Government of Angola Institutions

Ministry of Energy and Water: Mr. Botelho de Vascancelos (Minister), Mr. Rui Augusto Tito (Vice Minister), Mr. Francisco Talino (National Director of Energy), Mr. Paulo Fernando Matos (Planning Director), Mr. Diogini Orsini (Electricity), Mr. Munzila Jackson (Renewable Energy), and Mr. Serafim Silveira (Licensing & Inspection)

Ministry of Petroleum: Mr. Herold Ekke (Resident Advisor)

Ministry of Finance: Mr. Pedro de Moraes (Minister)

ENE: Mr. Eduardo Gomes Nelumba (Director), Mr. Luis Mourão Garcês da Silva (Commercial Administrator), Mr. Kilele wa Tshama (Planning Administrator), Mr. David Feixeira de Carvalho (Commercial Director), Mr. Mateus Gaspar (Human Resources Director), Mr. José Marinho (Generation and Transmission Director), and Mr. Alcino Jai Junior (Finance Administrator)

EDEL: Mr. Armando João (Director General, Investments), and Mr. Carlos Ferreira

Sonangol Holding: Mr. Syanga Abilio (Vice President), Mr. José M.J. Sousa (Production Director), Mr. Antonio Orfao (Director Concessions), and Mr. Fernando Santos (Director Legal Department)

Cambambe Hydropower Station: Field Trip

Sonangol Distribuidora: Mr. Fernando J. Roberto (Executive Director, Trade and Commerce)

Ministry of Environment: Mr. Carlos Santos (National Director Environment)

Ministry of Fisheries: Mr. Jon Klepsvik (Advisor to the Ministry)

Foreign Investment Institute: Dr. Castorio

BAI: Dr. Ricardo de Abrio

BCI (Bank of Commerce and Industry): Mr. Generoso Hermenegildo Gaspar de Almeida (President)

BPC (Bank of Savings and Credit): Dr. José Massano (Administrator)

FDES (Fundo de Desenvolvimento Economico e Social): Mr. Paixao Franco (President), Mr. Amandio Esteves (Administrator), Mr. Joao Quipipa (Economist), and Mr. Daniel Antonio (Lawyer)

International Petroleum Companies

ChevronTexaco: Mr. Mike Allison (General Manager), Ms. Ana Major (General Counsel), Mr. Thomas Mitro (General Manager, Finance)

British Petroleum: Mr. Chris Spaulding (Deputy General Manager Block 18/31)

TotalFinaElf: Mr. Hubert des Longchamps (Director General), Mr. Michel Treier (Director General, Refinery) Mr. Rui Diogo (Sustainable Development Manager), and Mr. Patrick Toutain (Director Safety and Environment)

ExxonMobil: Business Representative

Non-Government and Other Organizations

Care International: Mr. Douglas Steinberg (Country Director)

Nova Cimangola: Mr. Steffen Kasa (Managing Director), Mr. Bruce Willis (Technical Director)

Blackwood Hodge: Mr. Carlos Pacheco (Director General)

JEMBAS: Paul Wesson (Commercial Director)

ADRA (Associacao de Desenvolvimento Rural e Ambiente): Mr. Luis Monteiro (Director), and Mr. Fernando Pacheco

C. Norway's Agreement of Support

ANNEX 1

SUMMARY PROJECT DOCUMENT

Programme name	Technical support to the Electricity Sector in Angola		
Implementing Agency:	Ministry of Energy and Water (MINEA)		
Goal	To contribute to the economic and social development of Angola through strengthening the effectiveness and the efficiency of the electricity sector.		
Purpose	To improve the electricity production and distribution in Angola through establishment of policy, a legal and institutional framework and strengthening of the institutions of the sector.		
Output	Policy documents and institutional framework for the electricity sector established Management information system revised and in use as intended. Institutional strengthening of EDEL developed in accordance with strategy plan. If deemed feasible institutional strengthening of ENE according to approved plans. Plans for rehabilitation of Cazenga substation completed. Spare parts for vital parts of the supply and distribution system delivered. Language training completed		
Input	Technical assistance channelled through institutional agreement with NVE.		
Overall budget (tentatively)	2000	2001	2002
Norad	15,0 mill	18,0 mill	19,0 mill
Other donors	na.		
Angola's contribution	Local salaries, office facilities, etc		
Project components	The main project is an institutional agreement between MINEA and NVE with the following components: -Follow up of the NESMA process -Institutional strengthening of EDEL/ENE -Pre-investment studies for the rehabilitation of the Cazenga sub-station. -Provision of spare part to Angolan power utilities -Language courses for executives in the energy sector -Program administration -Miscellaneous		
Important assumptions	Political development and security situation in Angola allow for proper working conditions.		

SUMMARY PROJECT DOCUMENT

Programme name	AGO 0012 Institutional co-operation MINPET		
Implementing Agency	Ministry of Petroleum (MINPET)		
Goal	To ensure that the petroleum resources are administrated in a way that contributes to a sustainable development of national economy and welfare.		
Objective	<p>To assist in building a competent organisation at the authority level, which can develop, direct and control the development of the sector. In order to reach this goal main emphasis shall be given to training and institution building, especially in the fields of environment, safety and resource management.</p> <p>To strengthen the competence and decision making basis at MINPET in performing their responsibilities as government organisation. To transfer experience from the Norwegian Petroleum Sector to MINPET staff in technical, economic and administrative fields.</p> <p>To assist in development of an adequate legislative system for the sector.</p>		
Output	<p>Legislative system including regulatory systems for implementation of control regimes for the petroleum sector with special relevance to safety and environment.</p> <p>Technical assistance given to establish strategies, management and planning routines etc. Technical assistance given to establish policy documents and institutional framework for the petroleum sector.</p>		
Input	Technical assistance channelled through an agreement with NPD.		
Overall tentative budget NORAD	2000 7,020 mill	2001 8,160 mill	2002 6,820 mill
Other donors	na.		
Angola's contribution	Local salaries, office, accommodation, etc		
Project components	The main components are legal framework, petroleum resource management, safety and environment, training and some down-stream activities.		
Important assumptions	Institutional agreement with NPD established.		